INSURANCE

THE HOME INSURANCE COMPANY
NEW YORK

INDEX

Address of

Mr. Frederic C. Buswell

President

The National Board of Fire Underwriters

Before

The National Association of Insurance Agents

Louisville, Ky., October 16, 1919

THE HOME INSURANCE COMPANY
NEW YORK

LLOYDS EXCESS COVERS CRITICISED

SPRINGFIELD WARNS OF EFFECT ON AGENCY BUSINESS.

Vice President Bulkley Says That Treaties of Hartford and Continental Give Them Undue Facilities—Premiums Going Abroad.

The excess covers arranged by some of the large American companies with Lloyds' London underwriters are made the subject of criticism by Vice President George G. Bulkley of the Springfield Fire & Marine in a circular letter to the company's field men. This subject was briefly mentioned in The Journal of Commerce a few weeks ago. Vice President Bulkley's main objection is the undue writing facilities these treaties with unauthorized concerns give the companies having them and the effect on the agency business throughout the country. He says:

"To Our Field Men: We are led to inquire if you are noticing any attempt by the Hartford Fire and the Continental and their allied companies to make a drive for large lines on desirable risks. Both the Hartford and the Continental have, we are led to think, secured at Lloyds certain excess reinsurance cover which gives them facilities of somewhere between $200,000 and $500,000 on a single risk. We have been asked in several cases to name lines to meet authorizations given by the two companies mentioned. Not long ago we received a communication from one of our loyal agents which we quote below for your information:

"You have probably noticed in a recent issue of The Journal of Commerce a statement of a new plan of reinsurance about to be effected between an American company and some British underwriters. This scheme was explained to me in some detail, and I see in it the first step for a drive to clean up the small American companies.

"The company making this arrangement is the Hartford, and already we have been quoted lines upon some of our brokerage business that indicates the drift of things.

"The reinsurance arrangement cuts off all specific ceding and practically does away with the necessity of maintaining a reinsurance department at the home office.

"The Hartford's contract, as explained to me, is that the underwriters take all the excess over the Hartford's net line for from ten to one hundred times, depending upon the character of the risk and the Hartford's loss experience on the class. For instance, I am offered the opportunity to place the entire insurance on the........ mills in one policy, the requirement in this case being $200,000, subject to one fire, which is ample. We understand that upon high class manufacturing property of modern construction the limit is $2,500,000.

"You can see at a glance where the American reinsurance business is going to get hit and where the smaller company will stand in an agency. Without question this is the most ambitious scheme for 'killing off competition' that has been developed, and is the first step toward 'playing a lone hand.'

"Many company managers will develop a crop of gray hair if the agents take to it as it is hoped they will.

"If the Hartford and the Continental are able to make this excess cover a success, companies such as the Springfield without a similar reinsurance cover are bound to meet with much resistance in their agency operations.

"Many agents will not be so unwise as to tie up the cover on certain of their large risks in one company. Others, however, in order to make a saving in office routine will, we do not doubt, take advantage of what seems to be a good opportunity to write one policy instead of fifteen or twenty. The arrangement such as is enjoyed by the companies mentioned is inexpensive to operate at the head office and therefore they are in a position to make a large saving in the way of clerical hire.

"There are many disadvantages from our viewpoint, but our chief interest at this time is to learn if our business is being attacked by the Continental and the Hartford through the facility which they are able to offer to our agents.

"If, as you make your rounds, any of our agents discuss this subject with you it might be well for you to understand that a very small percentage of the premium assumed by the Hartford and the Continental on large risks is retained by them. As, for instance, if it is a $500,000 line, $475,000 automatically is taken over by the London Lloyds through the excess cover. It seems to us that those of our agents who have the interests of American institutions at heart will not encourage practices which will send to foreign countries a large portion of the premiums which they produce, to be taken over by the same underwriters which are issuing in this country individual Lloyds contracts much to the disadvantage of local agents. It also seems to us that the field men of companies not having foreign excess cover can do much to make this form of so-called reinsurance protection unpopular with local agents."

I COUNT myself fortunate indeed that it has fallen to me to bring this message of greeting and good will because in your membership and in this audience there are so many with whom I have such close friendly relations, business and personal.

You have already been informed of the appointment by the National Board of Fire Underwriters of a standing Committee of Conference with your Association and it is most gratifying to know that the significance of that event is fully appreciated. It does not mean that we have differences that require adjustment or that either you or we are apprehensive of controversies or contentions in the future, but rather, I think, it is a recognition of a certain community of interest, privilege and duty in which a point of contact is needed if we are to utilize all our energies and influence to the best advantage.

Our two organizations deal with different phases of the same general subject and it is in the hope that your efforts and ours may be better co-ordinated, and that as we serve the public better we shall the better serve our own interests that we are here to-day.

At the outset it will perhaps be well to make clear to you precisely what the National Board is; what its activities are as well as its limitations. It is a voluntary organization of stock fire insurance companies, fifty-three years old and at present its membership of one hundred and fifty-one comprises practically all of the companies of any importance doing a general as distinguished from a purely local business. In its early days it attempted to regulate all details of the business, but after a turbulent experience extending over a period of some ten or twelve years, all control over rates and practices was abandoned in April, 1876, and ten years later the dead letter of authority over commissions was definitely renounced.

For more than two decades following this action the Board's chief function consisted of the preparation of statistical tables which comprised the principal feature of the annual reports.

It will be observed that long before any other line of business thought of organizing a trust, and indeed before that word was ever used in its present opprobrious sense, the fire underwriters had organized, operated and abandoned theirs, and for more than forty-three years there has been no such thing in the fire insurance business in this country.

One of the most interesting things in the history of the National Board is the steady and apparently inevitable way in which its activities have come to be more and more of a public service character. This, I am frank to say, was not originally intended, in fact, it was a matter of years before we ourselves became aware of the meaning of the changes which were taking place, but we are proud and happy to believe that the fire insurance profession has led all other great business interests in the United States in completing the cycle of this evolution. In other words, more than a generation ago, our business definitely and finally learned the lesson that business measures, which were even unconsciously oppressive of the public, were "bad business" for the companies and that conversely, public interest and underwriting interest were synonymous terms. This may sound like mere assertion, but those who have taken the time to study the somewhat checkered history of the National Board of Fire Underwriters will realize its absolute accuracy.

At the meeting of the Convention of Insurance Commissioners in Hartford last month one of the members complained that the companies had no central organization with which the state officials could confer and which could commit its membership on matters of rate—overlooking for the moment the provisions of many very explicit anti-trust and anti-compact statutes.

In passing it may not be out of place to remark that the underwriters have sometimes wished that the National organization or Conference of State Insurance officials had some such control over its own members, but no doubt they wish so, too, and it is through no fault of theirs that they haven't.

The evolution of our business offered from time to time opportunities for usefulness which the Board was not slow to improve until at the present time it has become a service institution of value not only to its members but to the public.

It holds but one meeting annually, its work being conducted under the direction of the following Committees, whose names suggest the nature of their functions:

Executive
Actuarial Bureau
Adjustments
Clauses and Forms
Construction of Buildings
Finance
Fire Prevention and Engineering Standards
Incendiarism and Arson
Laws
Membership
Public Relations
Statistics and Origin of Fires
Uniform Accounting.

The working force consists of the General Manager and office, and special staffs, and the general office in New York is a very busy place, employing at present one hundred and forty-eight people.

It would require more time than you can give me to go into a detailed discussion of the work of these Committees, but it may safely be asserted that there is no privately supported organization in the country doing more for the protection of life and property.

For example, we are maintaining Fire Prevention Engineering Service in three important fields. Our Committee on Fire Prevention and Engineering Standards maintains field parties of trained engineers who are constantly engaged in trying to eliminate conflagration hazards in American cities.

Our Committee on Construction of Buildings reviews most of the building codes prepared by the different cities and is laboring constantly to elevate their standards.

Our great Underwriters' Laboratories in Chicago, with a branch in New York, employ their large staff of technical experts and their really wonderful laboratory equipment in tests of all devices, materials and processes that directly, or indirectly, affect the fire hazard.

On the personal side our committee on Incendiarism and Arson is rendering assistance to fire marshals and other state and city authorities, and through its own staff of investigators is seeking to make the crime of Arson unprofitable—a work in which the local agents can and do co-operate very effectively.

Our Committee on Public Relations is conducting an extensive educational work in fire prevention which includes the publication of a widely circulated monthly paper, the promotion of fire prevention courses in thousands of school rooms and a great variety of other details all calculated to bring the public to an appreciation of the need of careful habits and precautionary measures.

Many of your members receive the publications of this Committee, and we shall be pleased to add to our mailing list the names of all others who desire to have them.

Even upon mere technical lines the public interest is a constantly dominating factor.

Our Actuarial Bureau, with its eighty-six employees and its equipment of classification and tabulating machinery and its millions of record cards in files, is making such a scientific study of fire statistics and causes as has never previously been attempted.

Many of you are familiar with the work of our Committee on Laws which has so often and so successfully defended your interests and ours no less than those of the public against misguided attacks in the form of hostile legislation. Under the direction of this Committee, the tax laws and other stat-

utes are construed and legislation affecting the business is watched, and when necessary it represents you and us at hearings on measures proposed for enactment.

Some very valuable assistance in this work has been rendered by local agents who, as constituents, neighbors and friends of influential legislators have introduced and secured for us an audience, enabling us to present our views to much better advantage and more effectively than any stranger could hope to do.

Many of you recall repeated and determined efforts to put the Federal Government in the fire insurance business, which were resisted by all the legitimate influences we could enlist and defeated with the greatest difficulty.

Local agents were very helpful in this work and I am glad of this opportunity to testify to the great value of the services they rendered. When we consider the calamitous results of Government operation of railroads, express, telegraph and telephone companies and, for one illustration, the unsatisfactory handling of claims for lost parcel post shipments insured by the Government, we cannot escape the conclusion that in averting this danger we rendered a very real service to the public as well as to ourselves. In this place I am sure it is unnecessary to enlarge upon this subject, but it is worth considerable to know that in case of need the underwriters and the agents will be found standing together to resist and resent any attack upon their business from whatever source it may come.

And now I cannot let this occasion pass without calling attention to what seem to be the peculiar responsibilities of the present hour, for the fire insurance profession from top to bottom has become conscious of a new and important aspect of its duty to the public; namely, that of an organized and systemized protective relation when the nation's interests are in peril.

You are all familiar with the war service which began upon March 26, 1917, ten days before the actual declaration of war and lasted until some weeks after the signing of the armistice. It is, therefore, not necessary to recall the various forms of activity whose large value has been attested by many letters from various government officials. I wish to state without reservation that the splendid co-operation received from thousands of local agents throughout the country was one of the strongest factors in achieving these results. The fact remains, however, that such a record once established, becomes a standard by which future achievements must be judged and in the light of which present plans must be made.

We have all of us, local agents, special agents, company officials and National Board alike, learned that the country's emergency recognizes no divergent lines of individual interest, but calls us unitedly into the common service.

So much for a word of retrospect. But now let it be noted that the national emergency, which we believed to have passed with the signing of the armistice, has merely taken on a new aspect and has reappeared in even more disquieting form. This form seems to be that of a widespread and determined effort to destroy the principles of democracy and to undermine the moral standards upon which these principles are based.

You will, I know, acquit me of any purpose to pose as an alarmist. The people of this nation in vast majority I believe to be industrious, upright, intelligent and genuinely patriotic. No one can question this fact after seeing the response which was made to all appeals during our nineteen months of warfare, but you will appreciate the difference which exists between a majority that has been dissolved into its original units and a minority that is active, purposeful and unscrupulous.

So long as the United States consisted of thousands of different groups and interests, each intent upon its own affairs, Germany thought us to be negligible in warfare. It was not until these groups and interests developed a common purpose and a mutually co-operative plan that the nation's strength was made effective. At that time our citizens ceased to regard themselves separately as Americans and thought of themselves unitedly as "America," which is to say that they ceased to focus their attention so exclusively upon the special rights and privileges which are supposed to inhere in American citizenship and became conscious of the tremendous responsibility which the great national unit "America" owes to humanity. It was that change of viewpoint from the separate to the collective and from privileges to duties which made our nation irresistible in its great task, for it was in a sense a substitution of spiritual standards for those which were merely material or political.

None of us had ever seen nor even imagined a machine so mighty, so complicated, but yet working with such single effectiveness as that into which our nation had become organized by the close of the war. Then on November 11, 1918, the hostilities ceased and straightway the need for a collective purpose seemed to have disappeared. The people did not consciously become less patriotic; they merely ceased to be dominated by patriotic thoughts and began to return quite naturally and inevitably into their old channels of action and interest.

The point now to be noted is that all lines of separation must again be forgotten and unity of patriotic purpose must again be restored in the face of a new danger which is not less menacing than the one we have passed. This danger comes from within, not from without. It is not centralized in a great military autocracy which can be combatted by recognized methods of warfare, but is found in an amazing dis-

semination of poisonous ideas and disintegrating doctrines whose results are being made manifest in a spirit of disorder and violence in many parts of the country.

For a few months following the close of the war, we were so filled with optimism and with plans for reconstruction that we were hardly conscious of the extent of this new menace. We were inclined to regard it as merely a spasmodic example of disorganization which follows a great conflict, and to feel that it was not more than a part of the nation's convalescence. This attitude of easy optimism permitted the spread of the danger which it ignored, until to-day, we are forced to awake from our dreams and to leave our Fool's Paradise.

We now can no longer question the existence of forces of destruction and disintegration, definitely organized, well financed, working industriously and insidiously to undermine everything which we hold of value in our American life and utilizing their immunity to push their propaganda with utmost diligence. This is not a situation which will automatically correct itself. It must be combatted just as definitely, just as systematically and in a spirit of just as patriotic determination as that which led America into the World War.

The great, sound, but disorganized and careless majority must revive its organization and become reanimated with its patriotic spirit. The forces of construction must go to war with the forces of destruction and must master them before the danger has been allowed to spread farther.

Whatever our several relations, we are here together as fire insurance men, and just as fire insurance men led the Nation in their organized response to the call of service in the spring of 1917, shall we not now be the first among the country's business interests to recognize and to combat this new menace to public safety?

In considering the subject we are struck with the fact that the new doctrines are not only anti-American in character, but are anti-American in propagation as well. Their exponents are largely those of foreign birth, and, in many cases, of foreign citizenship. Their most fertile field is found in the great mass of illiterate immigration which poured into this country during the decade and a half before the war and in the illiterate portion of our native born population. There is every reason to believe that a large part of its support is drawn from foreign sources and its most marked characteristic is a hatred for orderly liberty and for all that makes up American traditions and ideals.

The way to fight darkness is by light; the way to fight ignorance is by means of education; the way to fight anti-Americanism is by a great campaign of Americanization that shall be absolutely systematic, efficient and thorough.

The time has now come when all the forms of organization in this country which represent sanity and progress must

enlist themselves in the work of safeguarding America against the impairment of her ideals.

The fire insurance profession should again appear in the van of patriotic activity and I can think of no better service that your great association can render to its country than that of promoting the constructive spirit of active, militant patriotism in all the states and towns where it has membership. This spirit must find expression according to the local conditions which it finds, but it should be based upon a vigilant, outspoken and uncompromising Americanism.

Fire insurance men are conservationists whose training and instincts naturally oppose every menace to the public safety. In the new emergency, as in the one that has just passed, let us show our ability to see clearly and to act promptly, energetically and unitedly for the land we love.

The New Standard
Fire Insurance Policy
of the State of New York

(In Effect January 1, 1918)

As Compared with the Original Standard Policy

AN ADDRESS

DELIVERED BEFORE

The Insurance Society of New York

BY

MR. DAVID RUMSEY

THE HOME INSURANCE COMPANY
NEW YORK

The New Standard Fire Policy

The fire insurance policy is probably the most important contract in the world, and the New York standard form is a document upon which the safety of practically all property values in this country is dependent. While there are other forms of fire policies in use in the United States, the New York standard is the legalized contract in twenty-six states and serves as the foundation for establishing, and the guide for modification of fire insurance contracts in use throughout the rest of the country. The New York standard form was established by law in 1886. It was created at the insistence of the Legislature, but was prepared by the Committee on Laws and Legislation of the New York Board of Fire Underwriters. The interesting history of its origin by Mr. Kennedy, one of the members of the Committee which drafted the original New York standard policy, was presented to this society in an address delivered in November, 1911. I think it would be impossible to praise too highly the work done in the preparation of the original New York standard form. The difficulty of formulating a single contract to be applicable to the vast number of varying conditions of property insurance can scarcely be overestimated. The successful accomplishment of a most difficult purpose is indicated by the fact that the New York standard fire policy was continued in use without change for thirty-two years, and during that time comparatively few of its provisions have been nullified by the courts or disregarded as obsolete.

The original New York standard form was a liberal document, judged by the standards of the time in which it was prepared. The fact remains, however, that with the passage of time—with the broadening and uplifting of business standards and the increased public impatience with technicalities, the old contract became, in many respects, archaic and illiberal. It was prepared in an age which ante-

dated the agitation against capital and trusts. The representatives of insurance companies were jealous of their right to impose their views upon the insurance business. They intended to be just to their customers but they also intended that in case of doubt, the companies' interests should not be imperiled and this solicitude for the companies' interests resulted in certain provisions of the policy contract which, tested by modern standards, are, in certain cases unfair and in other cases unworkable.

The determination to revise the New York standard policy took official form in the year 1913 when the New York Legislature adopted a joint resolution directing the Superintendent of Insurance to submit to the National Convention of Insurance Commissioners a request for the appointment of a committee to investigate the necessity for changes and to recommend to the Legislature such changes as, in the opinion of the Committee, might be necessary. The Committee of Insurance Commissioners was composed of Mr. Emmet of New York, Mr. Young of North Carolina, Mr. Johnson of Pennsylvania, Mr. Mansfield of Connecticut and Mr. Ekern of Wisconsin. They requested the cooperation in their work of Mr. Shallcross, now of the North British & Mercantile Insurance Company, and myself acting for The Continental Insurance Company. As the work progressed it was done, not only in conference with the Insurance Commissioners Committee, but with the Committee on Laws and Legislation of the National Board of Fire Underwriters and with a number of more specialized committees, such as informal conferences of agents, brokers and adjusters, and the work continued intermittently for about four years before the new standard form was completed and enacted into law in the year 1917, the new policy to take effect January 1, 1918.

The new policy contains upon its first page what may be termed the contract of insurance reduced to its simplest form, relegating all of what may be regarded as the incidental provisions to the second page. These become incorporated into the contract by reference thereto in the main contract.

The contract, stripped of all qualifying clauses, may be defined as follows:

The company agrees to insure, or, in other words, to indemnify against loss or damage by fire to the extent of the value of the property.

This broad undertaking is subject to three vital limitations, namely, that the liability of the company shall not exceed either—

(1) The value of the property, or
(2) The replacement or repair cost, or
(3) The amount of the insurance named in the policy.

The value of the property, as used in the contract, is more precisely defined as meaning the "actual cash" value "at the time of loss or damage." Thus, the idea of speculative or future value is eliminated and the idea of any fictitious valuation founded upon the relation of the owner to the property is negatived. In ascertaining value, "proper deductions for depreciation" must be made.

The cost of repair or replacement, which is referred to in the policy, is subject to three qualifications:

(1) The replacement is to be with material of like kind and quality;

(2) Its cost is to be estimated on the basis of a reasonable time to make the repair or replacement.

(3) In estimating the cost of replacement, no allowance shall be made by reason of the fact that ordinances or laws require reconstruction or repair in a manner or with material more expensive than that which was destroyed.

Neither value nor replacement cost shall include compensation for loss resulting from interruption of business or manufacture.

A contract of insurance is a contract of indemnity. This has been established by a uniform line of judicial decisions founded upon sound reasoning. It is only as insurance effects indemnity that it can be economically justified and freed from the objections which would attach to gambling contracts which are against the public policy and void. It was with this view that many of those who were concerned with the drafting of the new form proposed to substitute for the words "does insure" the words "does hereby agree to indemnify," but the proposed change of phraseology was considered to be unnecessary in view of the many decisions to the effect that the word "insure" is practically synonymous with the word "indemnify." This idea of indemnity and indemnity only is, however, expressive of the guiding principle of a valid insurance contract. It explains all of the limitations upon the company's liability and the qualifications of the phrases used as set forth in the main contract of the new form. It shows that the purpose of the contract is to restore the insured to the position in which he was prior to the loss up to the limit of the indemnity which he has paid for (namely, the amount of the insurance) but that the values which shall be restored are only actual or commercial values, and that a proper limit of indemnity restricts insurance to cost of replacement of the thing destroyed as nearly as possible in the condition in which it was at the time of the loss.

The first page of the new form, viewed as a whole, is a contract of indemnity, and many perplexing questions will be solved wisely in the future, as they have been in the past, by bearing in mind that such is the meaning and the only legitimate scope of a policy of fire insurance.

The new form runs to the insured "and legal representatives." This is a substitute for the following language in the old form: "Wherever in this policy the word 'insured' occurs, it shall be held to include the legal representative of the insured."

The new form defines the insurance as covering "to the extent of the actual cash value (ascertained with proper deductions for depreciation) of the property at the time of loss or damage." This is a substitute for the following language of the old form:

> This Company shall not be liable beyond the actual cash value of the property at the time any loss or damage occurs, and the loss or damage shall be ascertained or estimated according to such actual cash value, with proper deduction for depreciation however caused.—(Lines 1 and 2.)

Thus the undertaking of the company becomes expressed in the affirmative instead of in the negative as formerly. The construction of the old policy and the new should be the same, for under the old policy the obligation of the company was held to extend to the value of the property, subject to the other limitations of the contract, although it was based altogether upon the judicial interpretation of the word "insure."

The new form limits the insurance as follows: "But not exceeding the amount which it would cost to repair or replace the same with material of like kind and quality within a reasonable time after such loss or damage, without allowance for any increased cost of repair or reconstruction by reason of any ordinance or law regulating construction or repair." This is an adaptation of the following in the old form:

> and shall in no event exceed what it would then cost the insured to repair or replace the same with material of like kind and quality;

in line 2 and also the following:

> nor, beyond the actual value destroyed by fire, for loss occasioned by ordinance or law regulating construction or repair of buildings;

in lines 41 and 42.

As a matter of form, the clause which was at lines 41 and 42 should follow the clause which it qualifies instead of being forty lines removed from it.

As a matter of substance, the omission of the words "the insured" in old line number 2 renders it unnecessary in the future to consider the relation of the insured to the cost of repair or replacement. Hereafter the subject will be treated upon an absolute rather than a relative basis. If the insured is in such a position as to be able to repair or replace at less than market cost, that circumstance would not necessarily be available to the company to decrease its liability in so far as it may be measured by the replacement cost and, on the other hand, if for any reason it is peculiarly difficult for the insured to replace and, consequently, the cost of replacement would be greater than market cost if done by the assured, that circumstance cannot be used against the company's

interests. Cost of repair or replacement should be treated on the basis of general market conditions rather than in its relation to any particular party, and it was with this view that the change from the old form was made.

Again, the change by striking out the word "then" and adding in the new form the phrase "within a reasonable time after such loss or damage" is in line with a rational and fair treatment of this subject instead of a technical one. As a result of this change, there should be no room for argument that the replacement cost which is referred to involves immediate action and the increased expense thereof instead of a reasonable time allowance in view of the situation and the character of the work of replacement.

The elimination of the words "of buildings" as formerly in line 42 was not intended as a change of substance, but was done merely because the words added nothing to the meaning of the sentence.

The insurance is further limited by the new form as follows:

and without compensation for loss resulting from interruption of business or manufacture.

The corresponding provision of the old policy was found in the paragraph at lines 38 to 44:

This Company shall not be liable for loss to............or by interruption of business, manufacturing processes, or otherwise.—(Line 42.)

The change is not one of substance but of form. As neither computations of the value of destroyed or damaged property nor estimates of its replacement cost are to be increased by loss from interruption of business or manufacture, it is important to the policyholder to be informed of this by an expression of the limitation as a qualifying clause immediately connected with the statement of the company's principal undertaking. If the indirect loss due to interruption of business or manufacture is to be insured it should be covered by use and occupancy or profits insurance.

The new form provides for insurance not only by fire but "by removal from premises endangered by fire." This provision is new. The provision in the old form was restricted to a qualified continuance of the insurance against fire loss in a new location, but provided for no liability for loss or damage incident to the removal (Old form lines 60 to 66). Some courts have held that loss or damage incurred in the process of removal made necessary by danger of fire, are proximately caused by the fire and therefore the insurer is liable. While this is open to question as a legal proposition, a sound public policy and the interest both of the insured and the insurers require that the company should assume such liability. Hereafter the obligation will depend upon a clear provision in the contract and uniform treatment of the subject will be required.

The new form refers to the property covered in the following language:

to the following described property while located and contained as described herein, (or pro rata for five days at each proper place to which any of the property shall necessarily be removed for preservation from fire), but not elsewhere, to-wit:

In the old form this clause read as follows:

to the following described property while located and contained as described herein and not elsewhere, to-wit:

All of this language is retained but between the word "herein" and the word "and" is inserted a clause in parenthesis continuing the insurance for five days at a place to which property is necessarily removed to preserve it from fire. The corresponding provision of the old policy was as follows:

If property covered by this policy is so endangered by fire as to require removal to a place of safety, and is so removed, that part of this policy in excess of its proportion of any loss and of the value of property, remaining in the original location, shall for the ensuing five days only, cover the property so removed in the new location; if removed to more than one location, such excess of this policy shall cover therein for such five days in the proportion that the value in any one such new location bears to the value in all such new locations; but this company shall not, in any case of removal, whether to one or more locations, be liable beyond the proportion that the amount hereby insured shall bear to the total insurance on the whole property at the time of fire, whether the same cover in new location or not.—(Lines 60-66.)

This provision of the old form was in terms flatly contradictory to the clause limiting the risk to the described location. It was more elaborate than the importance of the five-day risk warranted and it was ambiguous. The necessity for the elaboration was only because, by the old form, property removed as a precaution thereupon became outside the scope of the policy and had to be brought back under the terms of the policy for the five-day period by means of a clause which defined its participation in the insurance with the property not so removed. The effect of qualifying the general limitation as to location by the words in parenthesis, is to leave the removed property within the description of property insured, for five days after removal, and the words *pro rata*, which now have a recognized meaning in insurance terminology, define the extent of participation in the insurance, by property removed to one or more places, precisely the same as if the entire clause of the old policy were used.

The new policy reads:

Fraud, misrepresentation, etc. This entire policy shall be void if the insured has concealed or misrepresented any material fact or circumstance concerning this insurance or the subject thereof; or in case of any fraud or false swearing by the insured touching any matter relating to this insurance or the subject thereof, whether before or after a loss.

The old form read as follows:

> This entire policy shall be void if the insured has concealed or misrepresented, in writing or otherwise, any material fact or circumstance concerning this insurance or the subject thereof; or if the interest of the insured in the property be not truly stated herein; or in case of any fraud or false swearing by the insured touching any matter relating to this insurance or the subject thereof, whether before or after a loss.—(Lines 7-10.)

The omitted words "in writing or otherwise" added nothing. In the absence of expressed restriction upon the kind of concealment or misrepresentation intended, it is manifestly impossible to limit their meaning by implication, so as to require an additional phrase for the purpose of extending the meaning which results from the simple use of the words, without qualification. It was thought that the omitted words, "or if the interest of the insured in the property be not truly stated herein," have sometimes worked injustice upon the insured, without being necessary for the protection of the company against dishonesty. The statement of the interest of the insured, as set forth in the policy, may be made by the company or its agent, not by the insured. If the statement is erroneous by reason of concealment or misrepresentation by the insured, the policy becomes void by the operation of the clause at lines 1 to 6 referring to fraud and misrepresentation. But in the absence of fraud, the insurance should not be invalidated through any error of expression made by the company's agent but not induced by the wrongdoing of the insured.

The new policy contains a clause similar to the old form as to property which is not, and cannot be insured (new policy lines 7-9, old policy line 38). But the provision as to property excepted from the coverage now provides that the policy shall not cover

> nor, unless specifically named hereon in writing, bullion, manuscripts, mechanical drawings, dies or patterns.

The old form provided as follows:

> nor, unless liability is specifically assumed hereon, for loss to awnings, bullion, casts, curiosities, drawings, dies, implements, jewels, manuscripts, medals, models, patterns, pictures, scientific apparatus, signs, store or office furniture or fixtures, sculpture, tools, or property held on storage or for repairs.—(Lines 39-41.)

Thus under the new form unless so stated in the policy the company is not liable for loss "to bullion, manuscripts, mechanical drawings, dies or patterns" even though such property be within the general description of the property insured as shown by the description upon the first page of the policy. But all of the other kinds of property which by the old form could be covered only by rider now are within the general coverage of the policy if they are fairly within the general description of the property insured although not specifically mentioned.

The clause as to hazards which are not covered is the same as in the old policy (new policy, lines 12-19, old policy, lines 31-34).

The new policy reads as follows:

20 This entire policy shall be void, unless otherwise provided
21 by agreement in writing added hereto,
22 **Ownership, etc.** (a) if the interest of the insured be other than
23 unconditional and sole ownership; or (b) if
24 the subject of insurance be a building on ground not owned by
25 the insured in fee simple; or (c) if, with the knowledge of the
26 insured, foreclosure proceedings be commenced or notice given
27 of sale of any property insured hereunder by reason of any mort-
28 gage or trust deed; or (d) if any change, other than by the death
29 of an insured, take place in the interest, title or possession of
30 the subject of insurance (except change of occupants without
31 increase of hazard); or (e) if this policy be assigned before a loss.

Lines 20 and 21 are similar to the old form which read as follows:

> This entire policy, unless otherwise provided by agreement indorsed hereon or added hereto, shall be void.—(Line 11.)

The specific changes of language are that the wording of what is now clause (c) (Lines 25-28) formerly was:

> if, with the knowledge of the insured, foreclosure proceedings be commenced or notice given of sale of any property covered by this policy by virtue of any mortgage or trust deed.—(Lines 18-20.)

At the end of the present clause (d) the old form contained the following:

> whether by legal process or judgment or by voluntary act of the insured, or otherwise.—(Lines 21-22.)

These words were omitted in order to eliminate from the policy a qualifying clause which had been inserted as an attempt to make a change of interest, not attributable to any act of the insured, a voidance of the entire policy.

Except as explained, all the language in lines 20 to 31 of the new policy is taken verbatim from the old form and is to be found in line 11 and lines 16 to 22.

The important change of substance which should be observed in this connection is that in the old policy there were fourteen conditions, a violation of any one of which would terminate the entire insurance (Lines 11 to 30). Under the new policy, the number of conditions which terminate the entire insurance is reduced to five.

The five conditions retained in the new policy, as being of sufficient importance to justify the termination of the entire insurance unless brought to the attention of the company by written endorsement added to the policy, were placed in this category because of their vital importance and their essentially irrevocable character from the insurance point of view.

(a) If the insured is not the unconditional and sole owner of the property, he lacks insurable interest to the extent of the full value of the property insured. The case presented, then, is one where, in case of destruction of the

property, the insured loses only the value of a partial interest, but collects the value of the entire property. It is a case where over-insurance is necessarily involved and incentive to protect the property from destruction is necessarily removed. Knowledge of the facts, brought home to the company, is necessary in order to enable the company to limit the amount of the insurance to the insured's partial interest in the property, and the condition presented by such cases is, practically speaking, a permanent condition instead of a temporary one subject to removal during the life of the policy.

(b) A somewhat similar condition is presented when a building insured is upon ground not owned by the insured in fee simple, for, in such cases, the building is subject to be taken away from the beneficial ownership of the insured and the knowledge of this fact frequently presents a case where the insured becomes tempted to permit a destruction of the property which will enable him to collect the value of the building before it passes out of his possession. This condition also is a permanent rather than a temporary one as a matter of fire underwriting, for it is improbable that, during the life of the policy, the condition will be rectified by purchase of the fee of the property upon which the building stands.

(c) The beginning of foreclosure proceedings or notice of sale by virtue of a power of sale in a mortgage increases the moral hazard of the risk for obvious reasons and, as such proceedings will, in ordinary course, be followed by terminating the insured's interest in the property, the condition presented is not temporary or subject to removal during the existence of the insurance contract.

(d) A change of interest, title or possession (except change of occupants without increase of hazard) is practically always a permanent change so far as the life of any particular policy is concerned. It affects the essential conditions of the insurance and it may increase the moral hazard or require an increase of premium.

(e) An assignment of the policy before loss would change the most essential feature of the contract. If this were permitted without notice to, and consent by, the company, there would remain no opportunity for the company to select the parties which it is willing to indemnify. Such a change amounts to the making of a new and different contract of insurance.

The next paragraph of the new policy begins:

Unless otherwise provided by agreement in writing added hereto this Company shall not be liable for loss or damage occurring.

This clause is new. It must be read in connection with each of the clauses marked (a) to (g) following it (lines 35 to 61) as if each of the lettered clauses was immediately preceded by the words in lines 32 to 34 above quoted. The

arrangement is for convenience and to avoid repetition.

It should be observed here that, while all of the conditions which follow, numbered (a) to (f) inclusive (lines 35 to 58) were conditions of the old policy, the violation of which voided the contract, an essential change has been made as between the new policy and the old in that these conditions hereafter will void the policy only while the prohibited conditions exist, but will not void the entire policy for its entire term as was provided in the old form of contract. In other words, there is an automatic reinstatement of the insurance as soon as the prohibited condition ceases to exist. It is true that in certain jurisdictions and in certain circumstances courts have refused a literal enforcement of the old policy, but it has been unfortunate that the language of the old form was either so harsh or so ambiguous as to permit inconsistent treatment by the courts of various states in the matter of essential conditions of the fire insurance policy. It is hoped that the changes made in the new form will so clearly differentiate between the conditions which are intended to terminate the entire policy (lines 22 to 31) and the conditions which are intended only to suspend the insurance while the violations exist, that uniform treatment of the subject may hereafter be secured.

As to the various matters which suspend the insurance, if not permitted by indorsement the (a) clause (lines 35-37) as to other insurance and the (b) clause (lines 38-40) as to increase of hazard, remain in substantially the same wording as the old policy.

The next clause (c) as to repairs now reads as follows:

> **Repairs, etc.** (c) while mechanics are employed in building, altering or repairing the described premises beyond a period of fifteen days; or

The old form read:

> or if mechanics be employed in building, altering or repairing the within described premises for more than fifteen days at any one time. —(Lines 15-16.)

It will be noted that the substitute for the words "for more than fifteen days at any one time" is the following: "beyond a period of fifteen days." This change was made in order to bring out clearly, as the old form failed to do, the idea that a period of time is intended during which alteration or repair work is conducted although the work may not be continuous for some such reason as that a Sunday intervenes during the period.

The next clause (d) providing for suspension of insurance while certain fire producing materials are on the premises, warrants rather careful consideration. The new policy reads:

> **Explosives, gas, etc.** (d) while illuminating gas or vapor is generated on the described premises; or while (any usage or custom to the contrary notwithstanding) there is kept, used or allowed on the described

premises fireworks, greek fire, phosphorus, explosives, benzine, gasolene, naphtha or any other petroleum product of greater inflammability than kerosene oil, gunpowder exceeding twenty-five pounds, or kerosene oil exceeding five barrels;

The corresponding provision of the old form was as follows:

or if illuminating gas or vapor be generated in the described building (or adjacent thereto) for use therein; or if (any usage or custom of trade or manufacture to the contrary notwithstanding) there be kept, used or allowed on the above described premises, benzine, benzole, dynamite, ether, fireworks, gasoline, greek fire, gunpowder exceeding twenty-five pounds in quantity, naphtha, nitro-glycerine or other explosives, phosphorus, or petroleum or any of its products of greater inflammability than kerosene oil of the United States standard (which last may be used for lights and kept for sale according to law but in quantities not exceeding five barrels, provided it be drawn and lamps filled by daylight or at a distance not less than ten feet from artificial light.)—(Lines 22-28.)

The changes are as follows:

The word "Building" (old form, line 23) is changed to "premises" (new form, line 45).

The words following the word "building" which read "(or adjacent thereto) for use therein" are omitted. Thus, under the new policy, the generation of illuminating gas in an adjacent building which is not a part of the "premises" will not void the insurance, although the gas is for use in the insured premises.

The words "of trade or manufacture" which, in the old policy, qualified the words "usage or custom" are omitted (old form, lines 23-24) because believed to be unnecessary as usage or custom include the usages of trade or manufacture as well as all other usages.

The following dangerous products which were prohibited by the old policy are retained as voiding the new policy while they are on the premises: Fireworks, greek fire, phosphorous, explosives, benzine, gasoline, naphtha, petroleum products of greater inflammability than kerosene oil, gunpowder exceeding 25 pounds, kerosene exceeding five barrels.

The having of ether on the premises is permitted by the new policy.

Dynamite and nitro-glycerine become prohibited because they are "explosives" although no longer mentioned by name.

Benzole is the same as benzine.

One of the important changes in this section is the elimination of the reference to the "United States standard" for kerosene oil. Present day conditions have rendered this unimportant and it is not feasible for the great number of policyholders to test the grade of kerosene. Also, the prohibition against drawing kerosene and filling lamps except by daylight and at least ten feet from artificial light, is omitted. That proper care should be taken will be admitted, but to invalidate insurance for its omission was too severe a penalty.

The new suspension clause, which is applicable to factories only is as follows:

52 Factories. (e) if the subject of insurance be a manufac-
53 turing establishment while operated in
54 whole or in part between the hours of ten P. M. and five A. M.,
55 or while it ceases to be operated beyond a period of ten days;

The old form read:

or if the subject of insurance be a manufacturing establishment and it be operated in whole or in part at night later than ten o'clock or if it cease to be operated for more than ten consecutive days.—(Lines 13-14.)

The words "at night" are omitted as unnecessary because the words "later than ten o'clock" are changed to read "between the hours of ten p. m. and five a. m."

It was appreciated that continuous operation of a factory day and night increases the physical hazard of the risk during the day as well as during the night, as the continuous use may result in overheating of bearings, etc. The new form, however, not only prevents a voidance of the entire policy but continues the insurance in force during the daytime, even when the clause is being violated by night operation without consent of the company.

This treatment was thought sufficient for the protection of the company's interests as the penalty for violation, while much less severe than in the old policy, should be sufficient to induce the great number of factory owners to give the necessary notice and secure the necessary consent of the company.

In the last part of the sentence (line 55) the only change of substance is the substitution of "while it ceases" for "if it cease." The effect of this has been fully discussed.

The unoccupancy clause (f) (lines 56-58) is in the old language.

By the new policy the company is not, unless assumed by rider, liable for loss:

59 **Explosion,** (g) by explosion or lightning, unless fire
60 **Lightning.** ensue, and, in that event, for loss or dam-
61 age by fire only.

The old form was as follows:

or (unless fire ensues, and, in that event for the damage by fire only) by explosion of any kind, or lightning; but liability for direct damage by lightning may be assumed by specific agreement hereon.—(Lines 34-35.)

By the old form liability was limited to the fire loss following explosion or lightning. Direct loss by explosion could not be covered. Direct loss by lightning might be assumed by rider.

By the new form fire loss following explosion or lightning is covered by the policy without the necessity for a rider.

Both direct loss by explosion and by lightning may be covered provided the additional liability be assumed by rider.

The new chattel mortgage clause is:

62 **Chattel mortgage.** Unless otherwise provided by agreement in
63 writing added hereto this Company shall
64 not be liable for loss or damage to any property insured here-
65 under while incumbered by a chattel mortgage, and during the
66 time of such incumbrance this Company shall be liable only
67 for loss or damage to any other property insured hereunder.

The old form provided that

This entire policy, unless otherwise provided by agreement endorsed hereon or added hereto, shall be void. * * *—(Line 11.) or if the subject of insurance be personal property and be or become incumbered by a chattel mortgage.—(Line 18.)

It was felt that the operation of this clause was too harsh, although the principle underlying the clause was a sound one. It was thought that a chattel mortgage should only suspend the insurance upon the mortgaged property but should not affect the validity of the insurance upon any other property covered by the policy. It was also thought that when the prohibited condition was removed the insurance should be reinstated as to the property which formerly had been mortgaged. The clause was revised to accomplish these two purposes.

In testing the scope and effect of the chattel mortgage clause in the new form, the question arose whether, in a case of under-insurance of property, a part of which was encumbered by a chattel mortgage not permitted by endorsement upon the policy so that the company would not be liable for loss to the mortgaged portion of the property, the portion of the insurance otherwise applicable to the mortgaged part would go to increase the insurance of the unmortgaged part of the property. It was felt that the clause as drafted for the new policy would not be susceptible to this construction, for it seems clear that, while liability to pay for loss or damage to the mortgaged property was suspended, the insurance effected by the policy covers the whole of the property described in the policy, including the mortgaged portion, and the reason why the company is not liable for the loss to the mortgaged part of the property is not because that property has been excluded from the coverage, but because the insurance protection is suspended as to part of the property while the prohibited conditions are in existence.

The fallen building clause now reads:

68 **Fall of Building.** If a building, or any material part thereof,
69 fall except as the result of fire, all insurance
70 by this policy on such building or its contents shall immediately
71 cease.

The old form was the same except for the insertion of the word "material."

Many courts held that the old clause must be construed as limited to cases where a material part of the building fell —material in the sense of a substantial or an integral part. Such constructions are reasonable and the authority for them

should be found in the contract itself so that all may know their rights without the necessity of consulting judicial reports in order to learn them.

As to the subject of adding clauses to the policy, the new form provides as follows:

72 **Added Clauses.** The extent of the application of insurance
73 under this policy and of the contribution to
74 be made by this Company in case of loss or damage, and any
75 other agreement not inconsistent with or a waiver of any of
76 the conditions or provisions of this policy, may be provided for
77 by agreement in writing added hereto.

The old form provided that:

the extent of the application of the insurance under this policy or of the contribution to be made by this company in case of loss, may be provided for by agreement or condition written hereon or attached or appended hereto.—(Lines 98-100.)

This clause is continued without substantial change.

But there was another and an essential rule in reference to clauses which might be added to the policy, yet which nowhere appeared in the policy itself. The law of New York (Insurance Law, Section 121) provided that there might be added to the contract

any other matter necessary to clearly express all the facts and conditions of insurance on any particular risk not inconsistent with or a waiver of any of the conditions or provisions of the standard policy herein provided for.

The policy should show on its face what additional clauses may lawfully be added and it was with this in mind that the new matter was included as a part of this clause.

The new clause as to waiver is as follows:

78 **Waiver.** No one shall have power to waive any pro-
79 vision or condition of this policy except such
80 as by the terms of this policy may be the subject of agreement
81 added hereto, nor shall any such provision or condition be held
82 to be waived unless such waiver shall be in writing added hereto,
83 nor shall any provision or condition of this policy or any for-
84 feiture be held to be waived by any requirement, act or proceed-
85 ing on the part of this Company relating to appraisal or to any
86 examination herein provided for; nor shall any privilege or per-
87 mission affecting the insurance hereunder exist or be claimed by
88 the insured unless granted herein or by rider added hereto.

In this clause there are brought together under a single heading all the provisions of the old form relating to the subject of waiver, a part of which were to be found on the first page of the policy as follows:

and no officer, agent or other representative of this Company shall have power to waive any provision or condition of this Policy except such as by the terms of this Policy may be the subject of agreement endorsed hereon or added hereto; and as to such provisions and conditions no officer, agent or representative shall have such power or be deemed or held to have waived such provisions or conditions unless such waiver, if any, shall be written upon or attached hereto, nor shall any privilege or permission affecting the insurance under this Policy exist or be claimed by the insured unless so written or attached.

And another part on the second page as follows:

> This Company shall not be held to have waived any provision or condition of this policy or any forfeiture thereof by any requirement, act, or proceeding on its part relating to the appraisal or to any examination herein provided for.—(Lines 92-93.)

By doing this the revisers were able to eliminate repetition and useless verbiage and to place all provisions relating to the subject of waiver where they could readily be found.

The new cancellation clause is as follows:

> **Cancellation of policy** This policy shall be cancelled at any time at the request of the insured, in which case the Company shall, upon demand and surrender of this policy, refund the excess of paid premium above the customary short rates for the expired time. This policy may be cancelled at any time by the Company by giving to the insured a five days' written notice of cancellation with or without tender of the excess of paid premium above the pro rata premium for the expired time, which excess, if not tendered, shall be refunded on demand. Notice of cancellation shall state that said excess premium (if not tendered) will be refunded on demand.

The old form was as follows:

> This policy shall be cancelled at any time at the request of the insured; or by the Company by giving five days' notice of such cancellation. If this policy shall be cancelled as hereinbefore provided, or become void or cease, the premium having been actually paid, the unearned portion shall be returned on surrender of this policy or last renewal, this Company retaining the customary short rate; except that when this policy is cancelled by this Company by giving notice it shall retain only the pro rata premium.—(Lines 51-55.)

The cancellation clause of the old standard form is a striking example of the difficulty of making the language of a contract not only clear but so clear as to render it impossible of misunderstanding.

Notwithstanding the meticulous and careful work of the drafters of the New York standard form of 1886 as applied to this clause, the weight of judicial authority has determined its meaning to be contrary to what was intended. The clause provided that upon cancellation of a policy, the premium upon which had been paid

> the unearned portion shall be returned on surrender of this policy or last renewal,

yet many courts have construed the clause to mean that the unearned premium must be tendered at the time of cancellation in order that an attempted cancellation by the company might be effective. Perhaps the leading case on this subject is Tisdell v. New Hampshire Insurance Co. (155 N. Y. 163). There is no question that the public interest, as well as fairness to the companies, requires that an insurance company shall be permitted to cancel a policy without tender of unearned premium. It is frequently difficult for the company to reach the insured with a notice of cancellation and this is rendered increasingly difficult in cases where the insured is dishonest and tries to evade a cancellation notice. The under-

taking may involve the sending of several notices to different addresses, but should not involve multiple tenders of unearned premium. The public has a vital interest, though an indirect one, in having insurance cancelled in cases where suspicion of intended incendiarism is aroused and, therefore, the companies should be facilitated in effecting such cancellation provided the rights of the insured are protected. Assuming that a company was insolvent, it would be of benefit to any insured to have his policy cancelled so as to enable him to transfer the policy to a solvent company even at the risk of losing the unearned portion of the premium, but, practically speaking, companies are always in a position to respond to their obligation to refund return premium. It sometimes happens, however, that a policyholder is unaware of his right to collect a return premium on cancellation and provision is made in the new form for giving this information in all cases by requiring a statement in the cancellation notice to the effect that the excess premium, if not tendered, will be refunded on demand.

It is hoped that the statement of the new form that the policy may be cancelled by giving the insured a five days' written notice of cancellation

> with or without tender of the excess of paid premium above the pro rata premium for the expired time, which excess, if not tendered, shall be refunded on demand,

may state the proposition with sufficient clearness and elaboration to avoid conflicting decisions upon this point in the future.

It is also hoped that the clause is drafted with sufficient clearness so that the intention may be effective that only a single notice of cancellation is required, to effect termination of liability at the expiration of five days from receipt of the notice by the assured.

The new policy provides:

> **Pro rata liability.** This Company shall not be liable for a greater proportion of any loss or damage than the amount hereby insured shall bear to the whole insurance covering the property, whether valid or not and whether collectible or not.

The old form was as follows:

> This Company shall not be liable under this policy for a greater proportion of any loss on the described property, or for loss by and expense of removal from premises endangered by fire, than the amount hereby insured shall bear to the whole insuranc, whether valid or not, or by solvent or insolvent insurers, covering such property.—(Lines 96-98.)

The words "any loss or damage" are of broader import than the phrase used in the old form and include loss or damage by removal from endangered premises, as this kind of loss or damage is expressly insured against under the new form. The phrase "whether collectible or not" is somewhat broader in its meaning than the phrase "or by solvent or insolvent insurers" and includes all that the old phrase meant.

The new policy provides that:

106 **Noon.** The word "noon" herein means noon of
107 standard time at the place of loss or damage.

This clause is new. It effects a change in the policy as under judicial construction the word "noon" was generally held to refer to solar instead of standard time. In view of the recent custom of changing timepieces as the result of law or ordinance or common consent, for daylight saving, it becomes important to remember what constitutes standard time. Generally speaking standard time is the time used by railroads under an arrangement made in the year 1883 effective in the United States and Canada. The continent is divided into four sections, each of fifteen degress of longitude and each section takes the solar time of the centre meridian. Thus "eastern time" is the solar time of the seventy-fifth meridian. It is this system which is now read into the insurance policy. It continues regardless of daylight saving regulations based on custom or ordinance rather than statute law.

While such is the general situation as to construction of the words "noon of standard time" the subject has been controlled for the state of New York by statute since the year 1892 (Statutory Construction Law, Section 28; General Construction Law, Section 52). It was at that time enacted that standard time throughout this state should be that of the seventy-fifth meridian of longitude and the New York statute has recently been amended (Laws 1918, Chapter 112) so as to provide that the time of the seventy-fifth meridian of longitude should remain as standard throughout the state except that the standard time of the state should be advanced one hour on the last Sunday of March and retarded one hour on the last Sunday of October. Thus, the daylight saving time is standard in New York state although it differs from the time used by the railroads.

In March, 1918 (Act of March 19, 1918), Congress enacted a statute described as being

for the purpose of establishing the standard time of the United States.

The act legalized the standard time which had been established by railroad custom, except that it gave to the Interstate Commerce Commission authority to define the limits of each time zone and modify those limits from time to time, having regard for convenience of commerce, and it also carried into the law the daylight saving plan of advancing the time one hour between the last Sunday in March and the last Sunday in October. In August, 1919 (Act of August 20, 1919) the daylight saving feature of the act of Congress was repealed. The existence of the federal law presents a somewhat interesting question in view of its present conflict with the New York State law. In this connection it should be observed that the only effect which the act of Congress purports to have is that the time established by Congress

shall govern the movement of common carriers engaged in interstate commerce and shall govern the acts of officers of the United States and the construction of statutes of the United States (Section 2). It seems clear that in view of the limitations of the federal act, the clause of the standard policy of the State of New York established by the legislature is subject to the provisions of the General Construction Law in this state rather than the federal act, and that so long as the daylight saving provisions remain a part of the state law they are read into the fire insurance policy as indicating the time when the policy takes effect and when the insurance ceases. No doubt, the same condition exists in any other states which may now or hereafter establish the standard policy by act of legislature and then by another state law standardize time for the state on a basis other than that fixed by the federal statute.

Of course, in the absence of a state law on the subject, standard time is railroad time as there is no conflict between the federal act and the custom of railroads, nor can there be any such conflict, as the effect of any federal legislation necessarily changes the custom of railroads which constitutes standard time and controls the interpretation of the policy in the absence of specific statutes to the contrary.

The new clause as to mortgage interests should be critically considered. It reads:

Mortgage interests. If loss or damage is made payable, in whole or in part, to a mortgagee not named herein as the insured, this policy may be cancelled as to such interest by giving to such mortgagee a ten days' written notice of cancellation. Upon failure of the insured to render proof of loss such mortgagee shall, as if named as insured hereunder, but within sixty days after notice of such failure render proof of loss and shall be subject to the provisions hereof as to appraisal and times of payment and of bringing suit. On payment to such mortgagee of any sum for loss or damage hereunder, if this Company shall claim that as to the mortgagor or owner, no liability existed, it shall, to the extent of such payment be subrogated to the mortgagee's right of recovery and claim upon the collateral to the mortgage debt, but without impairing the mortgagee's right to sue; or it may pay the mortgage debt and require an assignment thereof and of the mortgage. Other provisions relating to the interests and obligations of such mortgagee may be added hereto by agreement in writing.

The only reference to mortgagee interests contained in the old policy was the following:

If, with the consent of this Company, an interest under this policy shall exist in favor of a mortgagee or of any person or corporation having an interest in the subject of insurance other than the interest of the insured as described herein, the conditions hereinbefore contained shall apply in the manner expressed in such provisions and conditions of insurance relating to such interest as shall be written upon, attached, or appended hereto.—(Lines 56-59.)

It will be observed that under the old form, the only provisions of the policy referred to were "the conditions

hereinbefore contained." In other words, the clause in reference to mortgagee interest provided the manner in which the provisions of the policy could be made to apply to mortgagee interests, but provided only a means for making applicable to mortgagee's interest in the provisions of the policy preceding lines 56 to 59 and did not provide any means whatever for making apply to mortgagee interests any of the provisions of the policy which followed lines 56 to 59.

It will also be observed that as to the provisions preceding lines 56 to 59 the form provided that they were to apply in the manner expressed in such provisions and conditions as shall be written upon, attached or appended to the policy. In other words, the rider relating to mortgagee interests must be looked to to ascertain how the conditions of the policy were to apply to such interests, and it was only as the rider in reference to mortgagee interests indicated the manner in which the policy provisions preceding line 56 should apply to such interests that they could be held to apply at all.

Under the old form, mortgagee interests were covered in one of two ways, either by a simple loss payable clause reading "Loss, if any, payable to John Doe, mortgagee" or by the standard mortgagee clause.

In the first case, the use of the words "Loss, if any, payable to John Doe, mortgagee" read in connection with the provisions in lines 56 to 59 to the effect that the policy provisions preceding line 56 should "apply in the manner expressed in such provisions * * * as shall be written upon or attached" to the policy, rendered it necessary to examine all of the provisions of the policy preceding line 56 in order to ascertain what, if any, loss was payable under the policy, and only such loss, as by this examination of the policy should be found to be payable, was due from the company to the mortgagee who had been made the appointee for payment of the loss. This made the mortgagee's interest in the policy subject to all of the policy conditions preceding line 56 which might constitute a defense available to the company against payment on account of loss. In other words, the mortgagee was subject to defenses available against the insured.

The situation thus presented was, in many respects, unfair. To meet it, the standard mortgagee clauses were prepared and very largely used for the protection of mortgagee interests. By these clauses, a mortgagee is made an appointee for payment through the use of the following language at the beginning of such clauses

> Loss or damage, if any, under this policy, shall be payable to blank as mortgagee [or trustee] as interest may appear * * *.

Thus, as in the first case above referred to, where the mortgagee is merely made an appointee of payment, the conditions of the policy preceding line 56 are read into the contract between the company and the mortgagee, but this situa-

tion is immediately qualified by the subsequent language of the standard mortgagee clauses which expressly provide that certain of the defenses which would be available against the insured shall not be available as against the mortgagee, that is to say, the mortgagee's interest in the insurance shall not be invalid by reason of any act or neglect of the owner nor by foreclosure proceedings or notice of sale or change of title or ownership nor more hazardous occupation of the property, provided the mortgagee shall notify the company of change of ownership, occupancy or increase of hazard which shall come to his knowledge, and, on demand, pay an increased premium. Also, express provision is made for cancellation of the policy as to mortgagee interests and for subrogation. In certain cases, the mortgagee clause, providing as outlined above, has been used, but with the addition of a provision for full contribution of all insurance whether carried by owner or mortgagee.

By the use of standard mortgagee clauses, a contract reasonably equitable in most respects as to the interest both of the mortgagees and the companies was created, for, under such clauses, the provisions of the policy preceding line 56 were read into the contract except as the mortgagee was freed from forfeiture of the insurance by acts or neglects for which the mortgagee was not responsible and of which he had no knowledge. But, even in the case of use of a mortgagee clause, no part of the policy following line 59 was applicable to the insurance of mortgagee interests. Therefore, such important provisions as those which require notice of loss, right of appraisal and limitation upon time of suit were entirely omitted from the contract with the mortgagee. This feature of the situation was the same whether a simple loss payable clause was used to cover mortgagee interests or whether a standard mortgagee clause was used for that purpose. In other words, the conditions of the policy following line 59 were completely omitted from the insurance contract in reference to mortgagee interests and could not be made a part of that contract because of the unfortunate use of the word "hereinbefore" in line 58. This situation was pointed out in a number of cases, the principal one being Heilbrunn v. German Alliance Insurance Co. (140 App. Div. 557, which was affirmed by the New York Court of Appeals and is reported in 202 N. Y. 610.) In the Heilbrunn case, the unsatisfactory character of the contract was commented upon and the suggestion made that the standard fire insurance policy should be revised to correct it.

The purpose of the new clause (lines 108 to 125) of the new policy is to continue the rule that the standard policy conditions shall apply to mortgagee interests as the policy conditions may be referred to and made applicable to such interests by rider added to the policy, but to broaden the old form so that any of the policy conditions may be made to

apply to mortgagee interests instead of limiting the conditions which may be made so to apply, to a part only of the conditions set forth in the policy. In addition to this, the purpose of the revisers of the new form was to provide expressly certain minimum essential conditions of the insurance contract covering mortgagee interests which should apply although not mentioned in the mortgagee clause attached to the policy. These minimum conditions are (1) cancellation as to the mortgagee upon ten days' written notice, (2) obligation of the mortgagee to render proof of loss within sixty days after notice of failure of the insured to do so, (3) making the mortgagee interests subject to the provisions for appraisal, (4) time of payment, (5) time of bringing suit, and (6) providing for subrogation. Thus, under the new form, if the only clause in reference to a mortgagee interest which is added to the policy is the ordinary loss payable clause there will thereby be read into the contract with the mortgagee all of the provisions of the standard form which are necessary to ascertain what loss is payable under the policy and, in addition, the provisions of lines 108 to 125 will apply to the contract with the mortgagee. If, on the other hand, a mortgagee clause is used, the conditions of the policy necessary to be examined in order to ascertain whether there is any loss under the policy will apply except as modified by the mortgagee clause and, in addition, the provisions of lines 108 to 125 will be a part of the contract with the mortgagee and will supersede any inconsistent provisions which might be inserted in a mortgagee clause.

The new requirements in case of loss read as follows:

Requirements in case of loss. The insured shall give immediate notice, in writing, to this Company, of any loss or damage, protect the property from further damage, forthwith separate the damaged and undamaged personal property, put it in the best possible order, furnish a complete inventory of the destroyed, damaged and undamaged property, stating the quantity and cost of each article and the amount claimed thereon; and, the insured shall, within sixty days after the fire, unless such time is extended in writing by this Company, render to this Company a proof of loss, signed and sworn to by the insured, stating the knowledge and belief of the insured as to the following: the time and origin of the fire, the interest of the insured and of all others in the property, the cash value of each item thereof and the amount of loss or damage thereto, all incumbrances thereon, all other contracts of insurance, whether valid or not, covering any of said property, any changes in the title, use, occupation, location, possession, or exposures of said property since the issuing of this policy, by whom and for what purpose any building herein described and the several parts thereof were occupied at the time of fire; and shall furnish a copy of all the descriptions and schedules in all policies and if required, verified plans and specifications of any building, fixtures or machinery destroyed or damaged. The insured, as often as may be reasonably required; shall exhibit to any person designated by this Company all that remains of any property herein described, and submit to examinations

152 under oath by any person named by this Company, and
153 subscribe the same; and, as often as may be reasonably
154 required, shall produce for examination all books of account,
155 bills, invoices, and other vouchers, or certified copies thereof,
156 if originals be lost, at such reasonable time and place as may
157 be designated by this Company or its representative, and shall
158 permit extracts and copies thereof to be made.

This is a revision of lines 67 to 85 of the old form.

The substantial changes from the old form are as follows:

(1) The insured must not only make an inventory but "furnish" the inventory to the company. Under the old form, it sometimes happened that an insured would insist that he had complied with the policy conditions by making the inventory without giving the company any beneficial use of it.

(2) The inventory, under the new form, shall include not only the damaged and undamaged personal property as formerly, but all property which was damaged or undamaged and, in addition, an inventory of the destroyed property. Such clauses are always interpreted as limited by the ability of the party to perform them and the insured will be required under the new clause to state all that he knows or can, with reasonable diligence, find out as to the items of destroyed, damaged and undamaged property.

(3) The obligations of the assured to exhibit all that remains of property and to submit to examination under oath and to produce books and vouchers are all qualified by the phrase "may be reasonably required."

(4) Under the old policy, the place required for production of books must be reasonable and under the new policy, not only the place, but the time for such production as may be required by the company must be reasonable.

(5) The old policy provided that the insured

shall also, if required, furnish a certificate of the magistrate or notary public (not interested in the claim as a creditor or otherwise, nor related to the insured) living nearest the place of fire, stating that he has examined the circumstances and believes the insured has honestly sustained loss to the amount that such magistrate or notary public shall certify.—(Lines 77-80.)

This clause is omitted from the new policy. As Mark Twain might have said—just this one omission would make a reasonably good policy out of a policy that had no other clauses in it.

The provisions of the new policy as to appraisal are as follows:

159 **Appraisal.** In case the insured and this Company shall
160 fail to agree as to the amount of loss or
161 damage, each shall, on the written demand of either, select
162 a competent and disinterested appraiser. The appraisers
163 shall first select a competent and disinterested umpire; and
164 failing for fifteen days to agree upon such umpire then, on
165 request of the insured or this Company, such umpire shall be

selected by a judge of a court of record in the state in which the property insured is located. The appraisers shall then appraise the loss and damage stating separately sound value and loss or damage to each item; and failing to agree, shall submit their differences only, to the umpire. An award in writing, so itemized, of any two when filed with this Company shall determine the amount of sound value and loss or damage. Each appraiser shall be paid by the party selecting him and the expenses of appraisal and umpire shall be paid by the parties equally.

The old form read:

In the event of disagreement as to the amount of loss the same shall, as above provided, be ascertained by two competent and disinterested appraisers, the insured and this Company each selecting one, and the two so chosen shall first select a competent and disinterested umpire; the appraisers together shall then estimate and appraise the loss, stating separately sound value and damage, and, failing to agree, shall submit their differences to the umpire; and the award in writing of any two shall determine the amount of such loss; the parties thereto shall pay the appraiser respectively selected by them and shall bear equally the expenses of the appraisal and umpire.—(Lines 86-91.)

The important changes made by the new form, in so far as the subject of appraisal is concerned, are as follows:

(1) Compulsory selection of an umpire by an impartial tribunal is provided for. Appraisals under the old form frequently failed because of the necessity that the two appraisers should be able to agree upon an umpire in order that he might be selected. Their disagreement, whether from design or otherwise, was sufficient to block the appraisal and throw the matter of loss adjustment into the courts. In the year 1913, the State of New York, following the example of some of the other states, enacted a law to the effect that when the appraisers had failed or neglected for a space of ten days after both had been chosen to agree upon and select an umpire, it should be lawful for either the assured or the company to apply to any court of record in the county in which the property was situated, on five days' notice to the other party, to appoint a competent and disinterested umpire (Laws of 1913, Chapter 181).

The new sentence (lines 162 to 167) is in line with the recent legislation for the selection of an umpire in case of failure to agree and is undoubtedly in the interest of the efficient adjustment of losses where only questions of value are involved. Under the new clause, if the appraisers fail for fifteen days to agree upon an umpire either party may, without notice to the other, apply to a judge of any court of record in the state for the appointment of such umpire. The effect of this clause should be for the future what it has been in the past, that is to say, in most cases the opportunity to compel the selection of an umpire results in the appraisers agreeing as to the person who shall be selected before the expiration of the fifteen-day limit.

(2) The new form requires that the appraisal shall be itemized. To this end, it is provided that the appraisal shall state the sound value and the loss or damage "to each item" (line 169) and that the award "so itemized" (line 171) shall determine the amount. The purpose of this change is to compel the appraisers to do their duty intelligently and to avoid the loose and unsatisfactory work which, in the past, has frequently been prejudicial to one or the other of the parties in interest.

(3) Another change in the new form is the addition of the word "only" in line 170. It was implied in the old form that only differences arising between appraisers should be submitted to the umpire. But the failure to state this clearly has resulted in many cases where the umpire and one of the appraisers practically make the award without participation by the other appraiser. The appraisers should be compelled to attempt, in so far as possible, to agree before calling upon the umpire to settle their differences.

(4) Under the old form, the award determined only the amount of loss and damage. Under the new form, the award will, in addition, determine the sound value of the property (line 172). Thus, the award, in the future, will be in such form as to serve as a foundation for a settlement of all differences as to value, including such differences as may arise as to the relation of insurance to value, which becomes of importance wherever there is a question involving co-insurance.

The clause as to the company's options now reads:

176 **Company's** It shall be optional with this Company to
177 **options.** take all, or any part, of the articles at the
178 agreed or appraised value, and also to
179 repair, rebuild, or replace the property lost or damaged with
180 other of like kind and quality within a reasonable time, on
181 giving notice of its intention so to do within thirty days
182 after the receipt of the proof of loss herein required.

The old form was as follows:

It shall be optional, however, with this company to take all, or any part, of the articles at such ascertained or appraised value, and also to repair, rebuild, or replace the property lost or damaged with other of like kind and quality within a reasonable time on giving notice within thirty days after the receipt of the proof herein required, of its intention so to do.—(Lines 4-5.)

The changes of phraseology are as follows: The word "however" is omitted. The words "such ascertained" are changed to "the agreed." The words "of loss" are added after "proof" (line 182). The phrase "of its intention so to do" is transferred so as to follow the word "notice."

The clause prohibiting abandonment of property (lines 183-184) is substantially unchanged.

The new policy provides:

> **When loss payable.** The amount of loss or damage for which this Company may be liable shall be payable sixty days after proof of loss, as herein provided, is received by this Company and ascertainment of the loss or damage is made either by agreement between the insured and this Company expressed in writing or by the filing with this Company of an award as herein provided.

The old policy contained two clauses in reference to time of payment, one expressed in the affirmative, as follows:

> and, the amount of loss or damage having been thus determined, the sum for which this company is liable pursuant to this policy shall be payable sixty days after due notice, ascertainment, estimate, and satisfactory proof of the loss have been received by this company in accordance with the terms of this policy.—(Lines 3-4.)

and the other expressed in negative form, which read as follows:

> and the loss shall not become payable until sixty days after the notice, ascertainment, estimate, and satisfactory proof of the loss herein required have been received by this company, including an award by appraisers when appraisal has been required.—(Lines 93-95.)

Except in the case of denial of liability, which throws the claim into controversy and litigation, the "ascertainment" of the amount due under the policy is made in either one of two ways:

1. By agreement between the insured and the company,
2. By award of appraisers.

The "ascertainment" may be made within the sixty-day period allowed for filing proof of loss. It may, and in the case of appraisal and award, usually does follow that period. As a matter of sound public policy, as well as for the protection of the company's interests, a means should be provided for compelling the rendition of a proof of loss in connection with the payment of any loss, however the amount thereof may be ascertained, and the policy clause provides that the liability for payment shall be sixty days after the two acts necessary to fix and prove the amount due, have been performed by the assured. One of these acts is the filing of proof of loss with the company, and the other is the ascertainment of the amount, either by written agreement or the filing of an award of appraisers, depending upon which of the two means of ascertainment is taken by the parties

By the old form the time of payment was dependent, not only on the rendition of the proof of loss and the ascertainment of the amount due, but also upon the giving "due notice" of the loss and an "estimate" thereof. The conditions of notice of loss and estimate thereof as bearing upon the time of payment, are eliminated. In the old form, it was provided that the time of payment was sixty days after "satisfactory proof of loss." The word "satisfactory" has been omitted and no longer qualifies the phrase "proof of loss." The question of what is satisfactory to the company as a proof

of loss no longer arises and the only test of what constitutes a proof of loss is the definition thereof as contained on the face of the policy. If the proof conforms to the requirement of the policy it must hereafter be satisfactory to the company.

The provision as to limitation of action on the policy is as follows:

> **Suit.** No suit or action on this policy, for the recovery of any claim, shall be sustainable in any court of law or equity unless all the requirements of this policy shall have been complied with, nor unless commenced within twelve months next after the fire.

This compares with the following language of the old form:

> No suit or action on this policy, for the recovery of any claim, shall be sustainable in any court of law or equity until after full compliance by the insured with all the foregoing requirements, nor unless commenced within twelve months next after the fire.—(Lines 106-107.)

The compliance required by the old form "by the insured" was unnecessarily restrictive. The compliance which should be required as a condition precedent to recovery by suit is a compliance with the terms and conditions of the contract, either by the party plaintiff to the suit or by his predecessor in interest under the contract, or both, as the case may require. It may be that suit is instituted by the legal representatives of the insured after death or by the legal successor in case the insured is a corporation. It may be that the cause of action for loss under the policy is assigned by the assured after loss. It may be that the suit is founded upon a mortgagee interest in property destroyed and that the contract covering such interest is valid and binding upon the company, although the insured has failed to comply with the provisions of the policy. The duty of compliance with the contract under the new clause falls upon the party plaintiff to the suit and any prior party to the contract through whom he derives his interest.

The new subrogation clause is as follows:

> **Subrogation.** This Company may require from the insured an assignment of all right of recovery against any party for loss or damage to the extent that payment therefor is made by this Company.

This compares with the language of the old policy which reads:

> If this company shall claim that the fire was caused by the act or neglect of any person or corporation, private or municipal, this company shall, on payment of the loss, be subrogated to the extent of such payment to all right of recovery by the insured for the loss resulting therefrom, and such right shall be assigned to this company by the insured on receiving such payment.—(Lines 102-105.)

Under the new form it is not necessary that the company shall assert the existence of a claim for recovery over against

a third party. It may require as a condition of payment of loss an assignment of such right of recovery as the insured may have against a third party, leaving the question of the existence of a valid claim to be ascertained by future examination of the facts bearing upon the matter.

It may be interesting to note the differences in form, arrangement and length as between the old and the new policy contracts.

The old standard form was so long and so lacking in arrangement that the assured was required to read practically the entire policy whenever he desired to ascertain any of his rights or obligations. In revising the policy, every effort was made to shorten it. It was found, however, to be utterly impracticable to make the policy appreciably shorter without sacrificing either the substantive rights of the parties or their clear expression. The old policy contained 2,441 words while the new policy contains 2,063 words, a shortening to the extent of 378 words.

The condition of the law in reference to insurance of mortgagee interests was found to require additional provisions in the new policy not contained in the old standard form. Thus, the part of the new policy devoted to a definition of the rights and obligations of mortgagees contains 189 words, whereas the old policy provision comprised only 73 words, so that aside from the mortgagee interest clauses the new policy has been shortened to the extent of 494 words out of a total of 2,441.

While it was not feasible to provide for the policyholder's convenience a contract very much shorter than the old standard form so far as the actual number of words used, a great improvement in this respect was effected by dividing the policy into three parts—combining in the first part of the policy all the provisions defining the rights and obligations of the assured before loss, following this by the provisions relating to mortgagee interest and then adding at the end of the policy all the provisions applicable after a loss has occurred. The first part of the policy under this classification comprises 1,159 words and, thus, the policyholder, for his protection and information, prior to a loss, is required to read less than half the number of words which were necessary to examine under the old standard form. If the insured is a mortgagee, the second part of the policy must be read, comprising 189 words. It is necessary for the assured to read the balance of the policy (comprising 716 words) only, in the event of a loss, to inform himself of his rights and duties after the happening of a loss.

The convenience of the assured is also materially increased by the use of a marginal index.

In conclusion I shall refer to a single point which may prove to be the most important feature of the new policy. As the old policy was concededly framed by the companies

and by them presented to, and filed with the Secretary of State, it has always for that reason, been judicially construed by resolving all doubtful points against the interests of the companies which drew the contract. The new policy does not admit of this interpretation. It was prepared at the direct instance of the New York Legislature. The work was done as the Legislature prescribed, under the direct auspices of the National Association of Insurance Commissioners. Every line and word of the new form has the authority and the sanction of the supervising officers of the country acting in the general interest of the insurance public. There is no longer opportunity to claim that the policy should be construed against the interest of one of the parties and in favor of the other. It has been given the authority and the prestige of a clear enactment of the New York Legislature, and in addition it is so completely the work of the National Association of Insurance Commissioners, as to entitle it to be called henceforth The National Insurance Policy.

Clay Working Plants

Suggestions for Inspection

THE HOME INSURANCE COMPANY
NEW YORK

Suggestions for Inspection of Clay Working Plants

Clay working plants, taken as a class, present several distinct fire hazards which are common to all; but under the various nature of the product as put upon the market, these general hazards are either modified or aggravated by special methods of treatment in the processes incident to the production of the finished material, but, at the same time, there appears to be sufficient similarity in the general hazards to warrant the segregation of the whole class into several groups or sub-classes, wherein it may be expected that the hazards developed in any one will be also found to prevail in all of such sub-class, and in an attempt to reach such sub-division as will include the approximate fire hazard of each group, the following classification has been adopted:

(1) Vitrified Pipe or Tile.
Common Stone Ware.
Common Yellow Ware.

(2) Building Brick.
Fire Brick.
Paving Brick.

(3) Toilet Ware.
Encaustic Tile.
Mosaic Tile.

(4) Art Pottery.
Decorated Ware.
Table Ware.

Classes No. 1 and No. 2.—The principal fire hazards due to the process methods of this group are to be found first, in the system of drying the green stock; second, in that of burning or firing the same after being dried, and third, in the presence and use of mixed oils at the recompressing machine, as in paving brick and similar work.

The method of producing tile or pipe consists of forcing the prepared clay under heavy pressure over mandrels inside of the mold or forming device; when formed the product is first partially air dried and transferred to the hot air or steam drying device and when sufficiently hardened, is coated with some vitrifying compound and burned in the kilns.

So-called "common" stone ware (as jugs, crocks and the like) and yellow ware (bowls, pie dishes, jars and urns) are formed by hand from prepared clay on a potter's wheel, dried under low steam heat, then coated with a glazing compound and burned in kilns; this class of ware is seldom ornamented or decorated to any extent.

The method of producing brick included in this class is practically identical for each variety in so far as relates to their formation from the prepared clays, the material being forced under heavy pressure through a press which may form the brick into separate units, or in a ribbon the thickness of the brick, from which the units are cut by hand or machine.

When formed as above, both building and fire-brick are partially air dried and then kiln dried prior to burning in a kiln. Paving brick is treated with a coating of heavy mixed oils as it is formed at the machine, then dried in tunnels under hot air or steam heat, and burned in kilns.

Drying of Green Ware, when carried on inside of the main plant, or in any combustible structure, can be approved only where low pressure steam heat is used, and when the steam pipes are safely arranged and freed from contact with woodwork or other combustible material; this method of drying to be accorded preference in all cases.

When drying is accomplished by the use of excess or waste heat from the burning or firing-kilns, it must be carried on in tunnels or ovens of brick, concrete, or fire-proofed metal construction, separated from the main structures as far as may be practicable; proper ventilation of the tunnels to be secured through brick stacks or chimneys, and the doors to both the charging and discharging ends of the tunnels should be of fire-proof construction.

Where ventilation of the tunnels is secured by the action of an exhaust fan, the fan-house should be of fire-proof construction and not prove an exposure to the main plant through the presence of unprotected window or other openings. The structure containing the suction or blowing fan, which exhausts the heated air and gases from the burning kilns, should be of brick, preferably fire-proof and not seriously exposing the main plant through unprotected window or door openings.

The hot air and gases from the burning or firing-kilns should be conveyed to the drying tunnels only through brick or other fire-proof conduits, preferably under the surface of the ground or so located as to not expose woodwork or other combustibles as part of the structure, or through the accumulation of refuse or other combustible material in contact with or contiguous to such conduits.

Where open flame gas heat is used for drying purposes in tunnels or kilns, there must be no woodwork or other combustible material in the structure, or in accumulation, exposed to the flame or subject to the heat generated thereby.

The presence and use of wooden flues or shafts for ventilation of drying tunnels or kilns should serve to condemn the risk; an exception to this ruling being possible only when steam heat is used and the other conditions of hazard seem favorable.

The Carriages or "Gigs" upon which the green ware is conveyed into the drying tunnels or kilns should preferably be wholly of iron or steel; wooden slats or shelves for supporting the ware on same being objectionable from the fact that they carbonize under heat and readily ignite at comparatively low temperature when in such condition; some manufacturers object to the use of metal slats on the ground that they are apt to cause the ware to check and crack.

Burning or Firing-Kilns should be constructed of brick and be provided with "down-draught" flues to brick stacks; to be fired with natural or producer gas flame, or by coal; be located outside of the main plant and not exposing combustible material of construction or environment, and not be under roof of combustible material.

Storage and Use of Oils, usually in large quantity at the forming or recompressing machines in paving brick works presents a marked hazard in the probable spread of fire if such material should become ignited, but the oils in use are practically inert in relation to the probability of spontaneous ignition, as they are usually a combination of vegetable and mineral oils, with sufficient percentage of the latter to prevent spontaneous heating when in contact with any fibrous material, but care should be exercised as to the proper location of the bulk storage and also to prevent the presence of open light or flame where mixing is done, or where the mixed oils are in use at the recompressing machines, or elsewhere.

Class No. 3.—The hazards incident to this group are somewhat aggravated over those of classes No. 1 and No. 2 in relation to the burning or firing-kilns, which are usually to be found located inside of the main structures and under roof or floors of same; hence, it becomes necessary to closely observe that the kiln walls are freed from contact or exposure to woodwork of floors, roof or other combustible material, by a clear air space of not less than three (3) inches all around the points of passage, and as particularly essential to safety that no combustible material shall be exposed within a distance of five (5) feet horizontally, or less than ten (10) feet vertically from the arch of the charging-door opening in the kiln. Protection against the vertical exposure of floors, roofs, or other combustibles should be secured by the presence of a metallic hood firmly and substantially attached to the walls of the kiln, directly over the arch of the charging-door opening; this shield or hood should extend not less than 18 inches from the wall of the kiln in a horizontal direction, and its outer edge be deflected, in order that the heat escaping from

the kiln when opened for discharge may be "banked-up" and carried to the outer air through the roof by a metallic vent or flue, firmly attached to the metal hood; a partially satisfactory method of ventilation may be secured by cutting away the roof boards over the arch of the charging door, the area of such vent to be equal to at least 1¼ times the area of the door opening.

When flat-top or low-arched-top kilns are in use, as frequently found in encaustic or mosaic tile plants, the vertical vents in such tops should in all cases show a clearance of ten (10) feet to the roof timbers, unless properly provided with firmly fixed metal hoods for deflecting the rising heated air, and when the limit of such clearance does not exceed five (5) feet, these deflecting hoods should be provided with vent pipes through the roof, and under both such conditions the roof immediately over the kilns should be amply ventilated by louvers or other open vents of such area as to insure prompt carrying off of the heated air.

Neglect of, or the absence of, such ventilating devices or their practical equivalents, should serve to condemn the risk where possibility of ignition of surroundings is apparent.

The method of producing toilet ware from prepared clays entails much hand work in building up units of large size, which are not subject to frequent rehandling or diversity of manipulation, and is generally without the hazards incident to ornamentation and decoration, and may therefore be rated as being the lesser hazard of the class to which it has been assigned.

Encaustic and mosiac tile are formed in dies under heavy steam or hydraulic pressure, the prepared clay used being in granular form, slightly moistened; leaving the die the tile are dried under low pressure steam heat and then placed in fire-clay saggers and burned in kilns, from which process they emerge as "biscuit" ware showing an unglazed surface upon which the ornamental or decorative design is applied by the use of various metallic oxides thinned with turpentine and held in solution or in the form of paste; the ornamented face is then coated with a slip-glaze and the design is fixed by firing in special furnaces.

The finished tiles are separately graded for accuracy of dimensions and trueness of surface by automatic machines which mark imperfect ware for ready identification.

These plants are usually of extremely large area, without fire wall divisions in the various separated structures. Saggers are usually made on the premises by hand power from refractory clays and are burned in specially designed kilns.

The process methods incident to the production of ordinary table-ware are somewhat less in hazard than those common to art and decorated ware with which it has been classed, from the fact that the processes are more simple up to the point where the ware enters the burning kiln, while

under present general practice ornamentation of this class of ware is confined to the application of decalcomania designs by transfer to the glazed ware, which is then fired. This method of decoration necessitates the presence on the premises of large quantities of prepared paper, and some accumulation of the waste from same.

In high grade or china pottery plants more extensive decoration is usual, and includes high class hand painting, both under and over-glaze by the use of colors derived from metallic oxides thinned with turpentine, the process adding 4
materially to the cost of the ware and necessitating frequent handling and firing in special furnaces or kilns.

The Process Hazards of classes No. 3 and No. 4, in addition to the general hazards above enumerated as being common to clay workers, include specific hazards due to the multiplication of heat-producing devices in use, such as "slip glaze" and enameling kilns, decorating and gilding kilns, and "frit" kilns, the nature of the latter being similar to a glass-melting furnace, including the high temperature common to same, the raw stock used being similar. The drying of the green ware is necessarily secured at the lowest possible temperature; hence, steam at low pressure is the prevailing method. Drying of the various grades of clay used is also compulsory at a low temperature, but is most frequently secured by fire heat in brick furnaces, without hazard from combustion of the raw stock.

It is, therefore, evident that the specific hazards of Class No. 3, which, as a whole, include the use of heat, are susceptible to control as to the fire hazard under the suggestions above enumerated as common to the clay-working class, *i. e.*, prevention of contact or serious exposure of woodwork or other combustibles to the devices generating heat and to the heated air emanating from same by radiation, or the direct flow of such heat vertically or horizontally.

Preparation of Pigments for Decorating.—These pigments are usually oxides of various metals, and in their raw or unmixed state present no particular fire hazard; it is only when volatile solvents are used for the purpose of rendering these pigments sufficiently fluid or plastic for application to the ware that any special hazard is to be apprehended from their presence or use. However, it is essential that careful inquiry and investigation should be made as to the nature, quantity and location of the bulk storage of such solvents, and also as to the quantity likely to be in stock for daily use, which latter supply should be as small as possible, and be contained in metallic vessels which would not permit the escape of the volatile or its vapors except when in immediate use (safety cans).

In tinting or shading art and decorated ware, both in under and over-glaze ornamentation, the coloring matter in

solution is sprayed on the ware under air pressure, the solvent in general use being turpentine, though in some varieties of cheap ware benzine or naphtha may be used; the spraying device is usually attached to a rubber tube which is liable to leak through deterioration in use, thus permitting the escape of the solvent or its vapors.

While the ware undergoing this treatment is usually surrounded by a metal hood or screen with an exhaust fan attached to carry off the fumes, no open light or flame should be permitted near the operating stand.

The Raw Stock used in the production of the finished ware or material peculiar to Class No. 3 (as also in Class No. 4) includes a wide range of grade or quality in the clays used in the mixtures necessary for the accomplishment of effects, rising in value from the common or native red clays to the high-priced German or other foreign imported article; but the manipulation of such raw stock, after it leaves the clay-drying device and until it passes from the hydraulic forming press or the potters' wheel to the green ware dry room, presents no greater hazard than such as is incident to the working of the moist or fluid clays through the various processes of crushing, pugging, elutriation with water, grading of the fluid mass through bolting reels; solidification of the semi-fluid mass by pressure, drainage and evaporation, the moist deposit thus produced being disintegrated in a granulating mill.

Each of these manipulations may be repeated a number of times before a satisfactory condition of the clay is secured, and each of such processes present conditions in retardation of rather than in aggravation of the fire hazard. The various grades of clay are usually deposited in separate bins or compartments, and the raw material is not then liable to other than slight surface deterioration as the result of contact with heat or fire, but is subject to damage by water.

Packing Material and Package-Making are hazards which may be considered as incidental to Classes 3 and 4, while frequently absent from Classes 1 and 2, but in any case should secure attention as to the bulk storage of the packing material, its location, and the removal of the day's excess from the plant.

Buildings.—Note material and class of construction; nature of interior finish; floor openings, and protection to same; kind of floors; nature of roof covering and support; character of walls separating buildings from each other or into sections; protection to openings in same; mutual exposure of buildings to be stated, and, if necessary, make diagram of same, or refer to map location.

Warehouses.—Note size and nature of structure, and its position in relation to the main plant; nature of goods and packages stored.

Management.—Note especially the items of cleanliness and order; observe matters of discipline, care of fire appliances and the appreciation of evident fire hazards, incident to processes or methods, discovering same by proper questioning of assured on such matters.

Motive Power.—Describe class of power used, and note general conditions; if gas or gasolene engine is used, note particularly whether the exhaust-pipe is properly freed from contact with wood or other combustible material; note whether the equalizing regulator on gas engine supply is of rubber or of metal; note smokestack, if any.

Fire Appliances.—Describe fully, noting public water supply, size of mains and pressure in same; location and number of public hydrants available; character of public fire department, and distance of nearest apparatus from the plant; nature of fire-alarm at plant.

Note especially all private fire appliances, including the fire pump, stating its capacity, the nature and volume of its water supply, bearing in mind that ordinary trade service pumps are not fitted for reliable fire service and are seldom entitled to credit as such; investigate sprinkler equipment, standpipes, hose, extinguishers, fire buckets and barrels, noting whether same are in condition for efficient service and the management familiar with their operation.

In General.—Investigate as well as possible the financial standing of the concern or assured; note whether signs of prosperity for the future and present condition of the trade. Note defects and suggest the proper remedy for same, and, finally, give expression to your personal opinion of the risk, and nominate the net line to be carried by the Company, and the rate at which it can be assumed.

F. M. Griswold

General Inspector

New York, July, 1915.

4

Cement Plants
...and...
Plaster Mills

The Home Insurance Company
NEW YORK

(Confidential)

Cement Plants

Before attempting to give consideration to the various processes and fire hazards incident to the manufacture of Cements, and without entering upon the field of historical data of this industry, interesting as it is, it appears proper to devote some space to the recital of the remarkable growth of the Portland cement industry since 1890, when the large demand for this material in construction work stimulated activity in the trade to place domestic production in competition with that of foreign manufacture, while at the same time the success attending the use of the rotary kiln in place of those of intermittent action and the general advance in the science of manufacturing cement, served to interest capital, and many new plants were established, the list of new ventures since that date is remarkable for its number, and the future holds promise of continued and profitable increase.

In 1891 the total consumption of Portland cement in the United States is stated at 3,443,126 barrels, of which domestic plants produced only some 13%—in 1899 the total net consumption is stated as being 7,650,382 barrels, of which domestic concerns furnished 73.9%, while the official figures for 1906 show domestic production of Portland cement to have reached 46,463,424 barrels of which only 8.5% is credited to wet process plants. This remarkable increase is not an evidence of overproduction, but is indicative of a healthy growth in the demand for the material, due to the ever broadening uses to which Portland cement may be put, and to its superiority over natural or Rosendale cement under all conditions where cement may be used to advantage. The displacement of Rosendale cement by Portland has become so widespread and general as to cause a marked reduction in the production of the former, many of such plants having been dismantled and abandoned, while in other instances they have been and are being converted into the Portland class at great expense due to the abandonment of old machinery and appliances and the substitution of new.

The Portland cement industry is a growing and prosperous one; the demand for high grade material is practically without limit and the supply of standard grade Portland hardly equal to the demand, hence, new plants will be established to meet the needs of the trade, and as in almost every state of the Union there may be found large deposits of limestone and clay or shale suitable for the production of standard Portland cement, the industry may be expected to expand in response to the growing demands, and under proper conditions as to construction and equipment, the class should prove profitable as commercial ventures.

The initial cost of a complete Portland cement plant is high, it being stated on good authority that in a wet process plant producing 1,000 barrels per day, the investment for the plant and equipment, without provision for working capital in reserve will range from $50,000 to $60,000 per rotary kiln, while a modern dry system plant and its equipment will range from $85,000 to over $110,000 per kiln, where the output runs as high as 1,500 barrels per day: doubling the output is said to reduce the cost of production by about ten cents per barrel. While the initial cost is high, the margin for profitable operation appears to be wide in view of the fact that in 1900 the cost per barrel of cement made by the wet or marl process averaged 66 cents and under the dry (limestone and clay) process the average was 55 cents, while the quoted mar- price for Standard Portland in large quantities was about $2.00 per barrel. Under improved methods of production since that date the cost price has doubtless been appreciably reduced, while the value per barrel produced in 1906 seems to average about $1.13 including all grades, good, bad and indifferent in quality. In view of the fact that a plant of less than four kiln capacity would find it difficult to profitably meet present competition, it does not seem probable that reckless expansion in the number of doubtful ventures is to be apprehended in the near future.

The classes of cement which are to be considered in the following remarks, while differing in many particulars as to individual characteristics, are each known as "hydraulic cements." A general and inclusive definition of the class known commercially as "Cement" is as follows:

Specifically, cement is a mortar or material which is capable of solidifying when in contact with water, without change of volume or notable evolution of heat. It differs from lime in that the latter crumbles, expands and gives off heat when exposed to water or excess moisture. A proper proportion of clay mixed with lime has a tendency to check crumbling and the evolution of heat and to bring about that quality of hydraulicity which characterizes cement.

Included within this broad classification the most important and valuable of the hydraulic cements is that known as "Portland," which is an artificial cement produced from

the intimate mixture of limestone or marl (carbonates of lime) and clay, with limited percentage of alumina and silica; each of these ingredients being accurately proportioned in the raw stock mixture before being burned. In some localities there are to be found natural deposits of so-called "cement rock" wherein the proportions of lime and clay are such as to render it fitted for the production of Portland cement without additions of any kind. Blast furnace slag is also used, in conjunction with lime, to produce Portland cement, and this combination seems to have a promising future before it.

Second in importance to Portland in this classification is that known as "Natural cement" (also known as "Rosendale" and "Lime-rock cement") which is produced from the so-called cement rock above mentioned without reference to the proportion of lime or clay constituting its composition, hence, the process of making this class of cement is always dependent upon chance for results, and while it is suited for many purposes in construction work, its use is gradually falling off for important undertakings where reliability is an essential.

Third in the classification, gauged simply on the amount of the material produced, comes Slag or "Puzzolan" cement, which is produced by the mixture of blast furnace and/or foundry slag with limestone in proper proportions. As in this process are used hitherto waste materials it is to be presumed that its future will show wide extension, though its past growth has been slow. None of this class came under inspection by the writer, hence, no attempt at description will be undertaken.

NATURAL CEMENT

The American Society for Testing Materials stipulates that "this term shall be applied to the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas." Tests of neat cement briquettes to show initial set in not less than ten minutes; hard-set in not more than three hours; to show a tensile strength of 50-100 pounds at end of 24 hours and of 200-300 at end of 28 days. (It is to be noted that no specifications as to proportions of lime and clay or other material are stipulated.—G.)

Natural cement is secured from cement rock or hydraulic limestone, which is a combination of lime and clay, in varying proportions; it is found in natural deposits of large area in Ulster county, N. Y., in the Lehigh valley in Pennsylvania and New Jersey, in southeastern Indiana, and elsewhere in smaller quantity. The preparation of cement from this rock is one of the most simple nature, it being only necessary to burn the raw stone in open top kilns, much like the lime kiln, grind the product to the proper degree of fineness and place it on the market.

The kilns are usually constructed of iron, lined with fire-brick, tapering toward the bottom where are placed grate-bars, below which are pits into which the calcined rock is dumped; process of operation is to make alternate layers of fuel and rock, ignite the fuel and draw off the calcined rock from the bottom about every 72 hours, the operation being continuous, more fuel and rock being added from top of the kiln as the calcined material is removed from below. These kilns are usually ranged in parallel groups, with track for removal of burned material between, and are generally without covering or enclosure.

The burned rock passes from the kilns directly to the mills, first through a crushing mill or coarse grinder, then to a screen, the finest dust passing to barrels as cement, the tailings going back to the coarse mill for regrinding, while the bulk of the crushed rock passes through this screen to the finishing mill which is usually a buhr-mill, whence it is again screened and barrelled or bagged as finished cement. The mill buildings are usually of light frame construction, detached from the kilns, and are seldom provided with other than wooden elevator legs and storage bins, this condition presenting an aggravated hazard, as the ground rock is frequently hot enough to set fire to the woodwork of the elevators and bins, even when iron lined. Aside from this special feature, the inherent hazards of the class are mild, being principally from friction at bearings from gritty nature of the product, and at screw conveyors if encased in wood, when movement of the material is retarded by "choking" of the screw, these being in addition to the ordinary hazards to be looked for in manufacturing plants of all kinds.

The general impression of the class, so far as inspections have gone, is not entirely satisfactory, owing to the rather flimsy and unfinished nature of construction, general carelessness evidenced in operation and management and the cheap class of help. The machinery used is simple and not of expensive character, hence, the values at a plant are not usually large; in southern Indiana such plants are found to range from three to over thirty kilns each, with an average possible output of about 100 barrels per day per kiln, many of them being operated but part time and under individual ownership, though most of the plants in that region are said to be in a "trust," or working under an agreement whereby the larger plants take care of the smaller ones while idle by apportionment of their respective quotas of operative capacity.

PORTLAND CEMENT

Portland cement differs from natural cement in that the ingredients entering into its composition (principally lime and clay with alumina and silica) are infrequently found in such natural proportions as to insure the production of a

cement of uniform quality, it being an axiom in general acceptance that "to accurately proportion the raw materials and to perfect an intimate mixture of them are the prime factors in making good Portland cement. Other things being equal, the more exactly the proportions are maintained the greater the uniformity of the cement; the more homogeneous the mixture and the finer the state of division of its particles, the greater the strength and hydraulic energy of the product." (Lewis.)

Hence, Portland cement is usually termed an artificial cement, and in the specifications for a standard of quality, it is stipulated by The American Society for Testing Materials, that, "this term is applied to the finely pulverized product 5
resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3% has been made subsequent to calcination." Tests of neat cement briquettes to show initial-set in not less than 30 minutes and hard-set in not more than 10 hours; to have a tensile strength of 150-200 pounds at the end of 24 hours, and of 550-650 pounds at the end of 28 days. (Compare with definition of Natural cement.)

The two essential ingredients in the manufacture of Portland cement are lime (60-65%) and clay (40-25%); the former is found widely distributed throughout the country in form of limestone, and less general and in smaller volume in the shape of marl, while deposits of clay suitable for the purpose are usually found in the vicinity of limestone and marl deposits. In addition to these materials which are artificially mixed in proper proportions to produce Portland cement, there are, as noted under Natural cement, large deposits of cement rock in the Lehigh valley region which is so proportioned in its natural contents of lime and clay as to be fit for the production of Portland cement without additions of either to balance, while in the same quarry portions of the deposit may need such additions to secure proper results, in which case limestone and clay of proper composition are to be found in the vicinity.

There are two methods of producing Portland cement in general use in this country, known respectively as the "dry" and the "wet" process, the former class including practically all of the plants using limestone and clay, or natural cement rock as the raw material, while in the wet process are included those plants in which marl and clay form the raw stock. (It is interesting to note that only about 8.5% of the total output of Portland cement made in the United States in 1906 was produced from marl by the wet process, the plants of this character being principally in Ohio, Indiana and Michigan and are usually to be found located at or near the shores of shallow lakes of glacial origin.)

THE DRY PROCESS

In the *dry process* the limestone or cement rock is blasted out at the quarry beds, elevated to a stone crusher where it is roughly broken, then passed to a direct fire heated dryer, usually a rotary iron cylinder averaging 5x50 feet and set at a slight inclination to the horizon, the fire being at the delivery end and the products of combustion passing through the cylinder and over the broken rock; passing from the dryer the rock is further broken in iron mills and elevated or carried on belt conveyors to raw stock bins, or may go direct to bins from the dryer if sufficiently reduced in size; clay from the pit or cars is dried in cylinders as noted for the rock, ground in edge-runner or tube mills, conveyed to stock bins and mixed with the crushed rock; the combined clay and limestone is then transferred to the "raw mills," where it is usually ground in ball mills and finished in tube mills to the consistency of fine meal; the ground raw stock may then pass to screens for grading, or go direct to iron feed hoppers placed at the upper ends of the rotary burning kilns. These kilns are constructed of steel, cylindrical in shape, ranging from 5 to 8 feet in diameter and from 50 to 130 feet in length (one plant proposes putting in kilns 200 feet long), lined with fire brick and set at a slight inclination to the horizon from feed to delivery end, and are slowly rotated by individual motors or engines, and are heated by the combustion of finely comminuted bituminous coal fed at the delivery end of the kilns under an air blast; the heat generated ranging from 2,500 to 2,800 degrees Fahr.

The finely ground raw stock passes slowly through the length of the rotating cylinder, subjected to a rapidly rising temperature as it approaches the delivery end of the device, from which it is delivered to the cooling device at a white heat in the shape of a pebbly "clinker." The method of cooling the clinker is not uniform in all of the plants inspected, but the general results are identical in that the clinker usually becomes thoroughly cool before it is passed to the storage bins or feed hoppers of the clinker mills. The method in use for grinding and finishing the cooled clinker into commercial cement, are almost as varied as are the ideas of the management of the plant, but as a rule the clinker passes from the feed hoppers to ball or Griffin mills for the first grinding, and then to the tube mills for finishing; from these it may go to screen or bolts for grading, and thence by conveyors to the finished stock warehouses, where it is usually stored in open bins for sixty days or more before being packed in barrels or bags and shipped.

Coal used as fuel at kilns and at boilers is of bituminous character of the so-called "high steaming" class; bulk stock is usually stowed in open piles, but may be found under cover or even inside of the coal grinding house. Practically all of such coal is prone to spontaneous heating in piles, this tend-

ency being aggravated when the ground coal is allowed to accumulate in heaps. In the preparation of coal for use at the kilns it is first passed through a crusher or rough-mill, then to direct fire heated dryers, elevated to iron hoppers and fed to Griffin or other pulverizing mills, usually located in the same compartment as the drying cylinder. In the best practice the pulverized coal passes from the mills by air blast to and through a dust collector, and thence by iron conveyors to the feed hoppers at the delivery end of the kilns, where, as above explained it is consumed within the kiln under air blast; in other instances the pulverized coal is elevated to a screw conveyor direct from the mills and thence to the feed
hoppers, as above; again, the pulverized material may be piled 5
on the floor in the dry house, or be stowed in bins inside of or attached thereto; both conditions being unsafe.

THE WET PROCESS

The operation of a *"wet process"* plant differs from that of a "dry process" only up to the point where the mixed ingredients enter the rotary kilns, from which latter point the methods and hazards are identical.

In the wet process the raw stock consists of marl and clay, (an exception as to class of raw stock may be noted here, as discovered at a plant where the marl deposit had become exhausted; here, limestone reduced to a fine powder was mixed with clay to form "slurry,") both being handled while in a moist condition. Marl is a natural deposit of carbonate of lime, ranging from 40 to 97% of carbonate; it is found in the marsh lands at the borders of lakes and under the water of same at practically all depths, and varies in thickness of deposit from a few inches to many feet. In operation the marl is secured from its place of deposit by the use of steam dredges, dumped into scows and towed to the works, or it may go from the dredge to dump-cars on tramways operated by steam, rope, motor or animal power; the marl may reach the works in a semi-solid state, if from the marsh land, but it usually is of a pasty consistency, say 60% water, and in this condition may be forced to the raw stock bins by air pressure from the dredge, or be lifted by pumps at the works, in which case it has been freed from stones and other extraneous matter by a separator on the dredge, this operation otherwise taking place inside of the mills; from the separator the wet marl goes to the wet-pan mill, edge runners and usually the clay is mixed with it and the combined material is ground in the presence of water; thence it passes to the tube mills, sometimes, in the older mills to buhr stones, and is finely comminuted; it is then termed "slurry" and is passed to an agitator or mixer, then to slurry storage tanks (where agitation is continued by air pressure to prevent stratification), from which it is elevated to hopper feed tanks, over the feed ends of the kilns, or it may be forced to that point by pump or by air

pressure. The slurry enters the kiln in a moist condition, holding from 35 to 45% of water which is vaporized and driven off as steam as the slurry slowly progresses through the kiln to the delivery end of the device. The clinker produced in this process is usually coarser and more lumpy than that of the dry system, thus necessitating separation before grinding and an extra crushing of these lumpy portions. Aside from this, the process from now on is identical with that of the dry process above described. The clay or shale used in the wet process is crushed and dried as described in the dry process.

CONSIDERATION OF HAZARDS

Raw Stock, *dry process.*—Cement rock, limestone and clay are each inert.

Raw Stock, *wet process.*—Marl and clay being always moist are also inert.

Finished Stock, *both processes.*—Having been subjected to extremely high temperature in the kilns possesses no combustible quality, but may retain sufficient latent heat from milling to set fire to wooden receptacles; hence, all elevators, conveyor boxes and storage bins should be of non-combustible material. It is also to be noted that owing to the presence of free lime in the finished product, all woodwork exposed to same loses its contained moisture and becomes as readily inflammable as punk, notwithstanding the fact of its being coated with the cement.

Fuel, *both processes.*—Class of coal being high-steaming bituminous it is liable to ignite spontaneously when in large piles as it comes to the plant, hence, it should be piled in the open and be frequently tested for heating; ground or pulverized coal being peculiarly susceptible to self-ignition should never be housed in large quantity inside of any structure, preferably, it should be prepared in only such quantity as will supply the needs of the kilns, to the hoppers of which it should be transferred from the mills by iron conveyors; the most satisfactory method being by airblast through metal pipes from mills to a dust collector; and thence by metal-cased screw conveyor to feed hoppers at kilns; if stored inside of buildings the bins should be of metal and of small capacity. Practically all of the coal used at the wet process plants in Ohio, Indiana and Michigan is that from the Fairmont mines in West Virginia, possessing the "fiery" characteristics of coal from that district.

PROCESS HAZARDS

Rock Crushing, *dry process.*—This constitutes a mild hazard as the cement rock or limestone is roughly broken up as it comes from the quarry by passing through jawbreakers or crushers of the so-called "coffee-mill" type. The surroundings are usually rough and not readily combustible.

Drying, *rock and/or clay.*—Both classes of stock are usually dried by being passed through slowly rotating iron cylinders which are heated by coal fuel, the flame and products of combustion passing through the cylinders in contact with the material and escaping at the upper or feed end of same through iron or brick stacks; these dryers are usually unenclosed, but as flame from the combustion chamber frequently is permitted to escape at the junction of the dryer and the firebox, the device should be kept free from exposure to or contact with woodwork or other combustible material; where the drying device is enclosed in masonry, the walls should be free from cracks and iron backstays be used for its support and be freed from contact or exposure to woodwork or combustibles. The hot stone should be conveyed through iron transmissions to the cooling pit or bin, before going to the raw stock warehouses for storage.

Drying Coal Fuel, *both processes.*—Coal is usually crushed by power in a coffee-mill device, though this is sometimes accomplished in an iron mill usually of the Williams type; is elevated to an iron hopper over the dryer, which is usually an iron cylinder enclosed in brick work and set at an inclination to the horizon from feed to delivery end, and heated by direct fires under the rotating cylinder in furnaces within its brick enclosures. The precautions noted above in relation to the location and arrangement of the raw stock dryers should be called for in this class. The dried coal passes by iron elevators to feed hoppers over the Griffin or other pulverizing mills, thence is conveyed to kiln hoppers or storage bins by elevators and screw conveyors, or as above indicated, by air-blast through metal pipes to dust collector; thence to kiln fuel hoppers by screw conveyors encased in metal, this method of handling fuel promising the greatest measure of safety from fire, as there is less finely pulverized dust held in suspense in the atmosphere. Coal ground in Griffin, tube and other partially open mills gives off much fine dust to the atmosphere, while the ball mills are but little less objectionable in that respect. I am advised that while the "Williams" mill used as a crusher of raw coal has seldom caused trouble, several fires and explosions are asscribed to its use for pulverizing the dried coal, an item well worth keeping in mind on inspection.

The extreme hazard of combining the fire-drying and pulverization of coal under the same roof does not appear to have very strongly appealed to the average manager of cement works, and yet it is the most striking and menacing of the processes incident to the production of cement. All drying devices should be separated from the grinding department in the manipulation of coal fuel, and that this method is feasible is amply demonstrated by the practice at the Atlas

Cement Co.'s works at Northampton, Penn., where drying of stone, clay and coal is carried out in the open, under ordinary shelter-roof sheds detached from other buildings.

Raw Stock Mills, *dry process.*—The broken raw stock, cement rock, or the mixture of limestone and clay is usually conveyed from the raw stock bins to the hoppers of the rough mills by belts, and is reduced to a coarse meal by passage through mills of various makes, from which the material may be graded on screens or in bolts, and then passed to the finishing mills, usually the tube mill pattern, the resulting output being very finely comminuted and the ingredients very intimately mixed. While some frictional heat is generated in these mills in the reduction of the hard stone, it does not appear sufficient to cause ignition of combustibles in contact with it, but the fine dust from the limestone has the quality of absorbing the moisture from the woodwork upon which it settles, as noted above in relation to the finished cement. An exception must be noted in respect to plants, which, while continuing to operate by the wet process, have substituted limestone in place of marl and must reduce the stone to extreme fineness in pulverizing mills run at such high speed and pressure as to heat the meal to a degree which might cause fire in contact with wooden conveyors or receptacles. In such cases elevator legs, conveyor casings and hoppers should always be of iron.

The grinding and mixing of raw stock (marl and clay) in the wet process plants carries no hazard with it, the materials being mixed and ground while in a fluid state as explained above.

Burning Kilns, *both processes.*—While the intense heat (2,500-2,800 deg. F.) generated in these devices during operation as well as that which is emitted by the hot clinker as it falls from the kiln, appears to present a very marked hazard, it is in fact quite a negligible item of the process, as the very intensity of the heat compels fire proof construction in its vicinity, as well as liberal space on all sides and a high roof to insure ventilation; the radiated heat however, will rapidly dry out any woodwork in the structure and render it more readily ignitable in case of fire from any cause. At one plant the wooden hand-rails to the stairways and galleries which are located well above the kilns, was found to be uncomfortably hot to the hand and it can well be conceived that a fire once started would spread with great rapidity under such conditions; hence, the presence of much woodwork such as platforms, galleries or roof boards in the kiln house deserves careful consideration by the inspector. Care should be taken during the process of cooling the clinker that it be kept free from combustible material, and that it be not stored in bins subject to ignition until it has become cooled; such bins should always be non-combustible.

The most dangerous hazard of the kiln room is found in the storage, handling and method of burning the pulverized bituminous coal fuel, as there appears to be the possibility of a dust explosion due to the delivery of an excess of the fuel from the feed hoppers, which may happen in the most approved system, when through accident or from carelessness the air blast is shut off before the delivery of fuel through the feeding device has been stopped; hence, any system which does not provide for the shut off of the feed before the air blast ceases, is dangerously defective, fire wise.

In the best practice, usual to modern plants, the coal is delivered to the tops of iron feed hoppers by screw conveyors enclosed in metal casing, and is automatically fed from the bottom of the hopper by a screw conveyor enclosed in an iron pipe, the end of which is connected to the air blast pipe leading to the kiln head; the pulverized coal as it falls from the feeder into the air duct, is met by a blast of hot air which forces it into the kiln in such state of distribution as to insure rapid and complete combustion with intense heat. Separate hoppers are provided for each kiln, the flow of fuel and the blast of air being controlled at each hopper by geared connection to the fuel feeding screw, and by a cut-off valve in a branch pipe from the general air blast. Under another and approved system, the power for operating the feeding mechanism and the air blast is secured from induction motors attached and individual to each hopper and air blast.

Where, as in the older practice, fuel is fed from the bottom of the hopper without the aid of a screw conveyor and is met by a fan blast as it falls, or where the fuel is forced to the kilns by being carried through the vanes of the fan with the air, the hazard is sufficiently pronounced to warrant positive declination of the risk.

Screw Conveyors—Where in use for the movement of hard and dry material, whether coal, raw stock, clinker or finished cement, should invariably be enclosed in metal casing, as they frequently become choked and the frictional heat generated by the action of the screw on the material banked up in its convolutions may become intense enough to ignite the encasement if it be of wood.

Electric Motors—Many of the plants now maintain their own electrical generating plants, and operate machinery and devices by individual motors, generally and preferably of the induction type, which are sparkless. It is evident that none but induction motors should be used where coal is ground or otherwise handled by power, as the sparking from the commutators of the direct current motors might easily ignite the material when in a finely comminuted condition; hence, whenever direct current motors are found in use for operation of coal drying or pulverizing devices, the hazard is sufficiently marked to warrant avoidance of the risk.

Causes of Fires—As a result of diligent inquiry and investigation as to the known causes of fires in plants of this class, the conclusion has been reached that where they have originated in the manufacturing sections and have not been the result of ordinary conditions incident to any class of risk, they have generally occurred in the coal preparation department; either from friction in the grinding mills, due to the presence of foreign matter in the coal, and usually resulting in an explosion as well as fire; or by ignition of coal dust in same locality from furnace fires at the dryers, and/or from spontaneous ignition of coal in piles, both ground and unground, inside and outside buildings.

Fires in finished stock warehouses mark a good second to those of the coal preparation localities, and when not due to normal or ordinary causes, it is my opinion that they arise from the clogging or choking of screw conveyors encased in wood, and as such casing is deprived of its contained moisture by the action of free lime in the cement which envelops it, it is in prime condition for ready ignition at a comparatively low temperature. A large majority of the finished stock warehouses inspected, developed the fact that roof boards were laid on wooden trusses supported by wooden beams and posts, while the open top cement bins were also enclosed in wood, with wood encased screw conveyors overhead or under floor level, or both.

In addition to the above notes on the hazards of processes particular attention is called to the following suggestions covering marked features of process hazard or of construction, which render a risk entirely objectionable and to be avoided, and in addition, to instances where the conditions are such as to warrant particular caution in taking chances on the outfit:

Decline all classes of cement works where the drying and preparation of coal fuel is carried on inside the main plant, or in adjoining structures not safely cut off.

Decline all classes of cement works where the kiln house is wood, or in which wood largely predominates in the structure.

Decline all cement works where wooden elevator legs, conveyor casings or storage bins are used in handling hot material.

Decline, as a rule, all classes of cement works where the daily output is less than 500 barrels.

Decline all kiln houses where pulverized coal fuel hoppers are not provided with screw conveyor feed control, or where fuel is directly fed to the kilns through the blowing device.

Decline all fuel preparation plants when both drying and grinding coal is carried on under the same roof; when ground coal is stored in bulk in the mill room; when the machinery is operated by direct current electric motors inside the structure.

Scrutinize carefully all plants which have been converted from old style intermittent furnace to rotary kiln process, or from marl to limestone raw stock, wet or dry process, as in each case much "junk" is to be found and the construction is usually faulty.

Scrutinize carefully all kiln or other buildings where heat is generated, where roofs with wooden sheathing or supports are low, and where much woodwork appears, as in galleries, platforms or machine encasements.

Scrutinize carefully finished stock warehouses where bins are of wood and screw conveyors are wood encased; in such cases the conditions aggravate the hazard seriously.

In addition to the above specific cautions, attention is called to other and inherent hazards, as noted in description of processes, all of which are worthy of careful consideration on inspection; there are also to be found other hazards not incident to the processes such as carpenter shops, machine shops, electric light plants, and perhaps a cooper shop, proper inspection of which should not be overlooked.

In a broader sense, it is desired to caution against acceptance of risks of the class under consideration which are built as the result of townsite "booms," or where the permanence of the venture is dependent upon uncertainty as to fuel supply, this caution being intended to apply especially to such plants as are dependent upon natural gas or fuel oil as a means of producing the heat necessary to the making of cement.

The past history of natural gas and the present monopoly of fuel oil each serve to prompt extra conservatism in acceptance of risks where either of these fuels are the sole source of heat supply.

WET VERSUS DRY PROCESS

In view of the fact that Portland cement when made from cement rock or from limestone and clay of suitable quality is credited by experts as being much superior in every essential respect to that produced from marl and clay, and therefore controls the market, it would seem that in competition the marl plants will have to be content with lower prices and curtailed profits to hold their own against the dry process plants, and when to this trade handicap we add the fact of the practically limited area of workable marl deposits as compared with the widespread and unlimited supply of limestone and clay of suitable composition for the production of Portland cement, the conditions appear to warrant much care in the selection of marl plants as subjects of insurance, and in support of this conclusion, the following remarks are submitted:

Deposits of marl, like those of petroleum and natural gas, are found only in restricted territory, and in each case, when the deposit has once been exhausted, there is no natural

replacement of the material extracted. The marl deposits cannot be profitably worked if lying under more than fifteen feet of water, or more than four feet of muck or peat bog; when the marl deposit is over twenty feet in thickness the lower portions are usually so contaminated with other matter as to render them useless as the basis for cement; hence, in working a marl bed it is apparent that the limit of profitable operation is confined within restricted areas, few if any of which give promise of extended availability.

It requires one-half of a cubic yard of marl as it comes from the deposit to produce one barrel of cement, hence, given a mill with capacity for say 500 barrels a day, it would need a surface area of one acre over a deposit of marl 18 feet thick for three months operation, or four acres per year of operation, and as a plant of 500 barrels per day capacity would involve an initial cost of at least $350,000, for plant and equipment alone, it is evident that a long term of years of successful operation would have to be assured to warrant so large an investment of capital, even if such an unusual deposit of marl as 18 feet should prove all workable during a period of thirty years, and both of these propositions are doubtful, as the average workable deposit of marl seldom exceeds a thickness of ten or twelve feet where the depth of water is less than fifteen feet, or that of the muck less than four feet, which, as stated above, are the extremes of the obstacles which may profitably be overcome in marl recovery.

Inspections developed the fact that several marl plants had exhausted the immediate deposit, necessitating "going far afield" for a new supply at the expense of building a railroad for transportation, or, as in one instance, the substitution of limestone for marl, and working it wet, rather than incur the expense incident to discarding the old equipment and replacing it by new for the dry process system. Under these adverse conditions the day of the passing of the wet process with marl and clay as raw stock, seems to be plainly marked, and its gradual replacement by the dry process system using limestone and clay is as plainly assured.

In support of the above conclusions, the following extract from the advance publication of the report of The United States Geological Survey, covering "The Cement Industry of the United States in 1906" will prove of interest:

"From what is known of the present condition of marl and slag plants, and of plans for future changes and new construction, it is probably safe to say that within four years more Portland cement will be made from slag than from marl. It must be recognized that marl plants operate under serious natural disadvantages, that these disadvantages are masked by general high prices during such prosperous seasons as we have recently experienced, but that they become painfully apparent during years of general depression. When cement sells at 85 cents or less per barrel at mills in the

Middle West, as it may very well do in 1908 or 1909, it will be an even more serious matter to have water in the raw mixture than to have it in the stock." (E. C. Eckel).

IN CONCLUSION

To insure success commercially a cement plant should possess the following points of advantage in its favor:

An extensive, readily handled deposit of raw material of purest character.

An outfit of the strongest and best designed machinery.

An output of large capacity.

Cheap power, either by water or by coal mined at or near site of plant.

Location such as to insure ample means of transportation for product.

Skilled operation and close adherence to accepted standard in composition of the finished product.

The nearer any plant combines the above conditions in its makeup, the more certainly will its profits be assured.

F. M. Griswold

General Inspector

New York, October, 1907.

Gypsum Plaster Mills

Cement plaster is variously known as "Stucco," wall-plaster, plaster of Paris, the latter term being the proper one, as it represents the material base of the others, it being the product of crushed and calcined or "cooked" gypsum.

Specifically and properly, "Stucco" is a mixture of plaster of Paris and glue, while wall plaster is a mixture of plaster of Paris with sand, wood or animal fibre, and/or other material.

Gypsum, from which plaster of Paris is made, is one of the softest of minerals; it is chemically classed as a calcium sulphate in combination with water. It is found in workable deposits throughout the United States, both as a crystalline rock and as a granular mixture of earth and gypsum, the latter being known as "secondary gypsum," also "gypsite" and as earthy gypsum. Both rock and secondary gypsum may occur in the same locality, but the earthy gypsum is generally confined to districts west of the Mississippi River, while the rock variety is widely distributed throughout the country, the most remarkable deposits of both rock and secondary gypsum being found in the almost unbroken formation extending in a southwesterly direction from Blue Ridge, Kansas to Quanah, Texas.

Gypsum is crystalline in structure, having a specific gravity of 2.32 in its raw state and of 1.81 when calcined. It is secured as rock from workings in open quarries, by drifting or tunneling into the deposits, or by shaft mining, and is usually thrown from placement by the use of dynamite.

Secondary gypsum or "gypsite" is found and worked principally in the States of Kansas, Texas and Wyoming, as well as in Oklahoma and Indian Territories. It is an earth of granular formation, usually deposited in swampy ground. It is soft and easily recovered by digging by hand or machine, and when mined, needs no preparation to fit it for calcination, hence, where it abounds, plaster of Paris may be more economically produced from it than from the rock gypsum, but as an offset to this economical feature, it is to be borne in mind that deposits of "gypsite," like those of marl (referred to in my report on Portland cement) are variable in volume

and not always of sufficient area and depth to warrant exploitation, hence, care should be taken to secure reliable information as to the extent of the deposit before acceptance of lines on plants using "gypsite" as sole source of gypsum supply in plaster manufacture.

The uses to which gypsum may be put are various, the raw rock when simply pulverized is known as "land plaster," and it is used as a fertilizer; also, under the term "terra alba" as an adulterant for wheat flour and in mixtures or compounds, as a base for insecticides, and as a retardent in Portland cement, but the principal use of the raw gypsum is for the manufacture of chalk crayons and like products.

Calcined gypsum is known as plaster of Paris, the finer grades being known as dental plaster when it has been carefully reground and freed from gritty particles, and a similar grade is much used for bedding plate glass on the polishing tables of glass works.

Wall plasters under various trade names are made from plaster of Paris mixed with a retarder, or by a mixture of plaster of Paris, a retarder and sand; and also by the admixture of animal or vegetable fibre with the plaster of Paris.

The gypsum industry is well established and is rapidly growing in many of the States and its production appears to be practically under the control of a few organizations, the principal of which are the United States Gypsum Co., the American Cement Plaster Co., and the Acme Cement Plaster Co. In 1903 the United States Gypsum Co. controlled eighteen plaster mills, thirteen mixing mills and three chemical plants, this corporation being capitalized at $7,500,000. In addition to these larger corporations there are many smaller ones and numerous individual plants of relatively small capacity.

PROCESSES.

The essential conditions necessary to the production of plaster of Paris or stucco are to reduce gypsum to the finest possible powder or "flour" before passing it to the cookers or calcining kettles, and then to apply only such degree of heat as will serve to carry off such proportion of its contained moistures as will prevent the voluntary "setting" or hardening of the finished material when exposed to the atmosphere. Hence, where the rock gypsum is used it is put through many processes of breaking and grinding to reduce it to proper degree of fineness for cooking, while in the use of "gypsite" or earthy gypsum, its natural condition of granulation permits it to go at once to the calcining kettles without preliminary treatment, thus insuring larger economy in handling than is the case with the rock.

The rock gypsum after being thrown down by blasting with dynamite at the mine or quarry is conveyed by tramway, usually, or an inclined trestle, to the mill, where, in most instances, the broken rock is passed through a brick encased

iron cylinder dryer, with direct fire heat, or may first be passed through a "jaw-breaker" and then to the dryer, or to the breaker without being dried. The rock, as it leaves the breaker is reduced to pieces the size of a man's hand and then dropped to the hopper of a second crusher or "cracker" of the coffee-mill type, from which it issues as a gravel, in which state it is elevated to feed bins over the grinding mills.

The broken rock flows by gravity from the bins to ordinary buhr mills (many of them being second-hand devices from old-style flour mills), where it is reduced to a flour-like fineness, and is then elevated to a bin over a second set of mills, usually of the vertical type, with emery-faced millstone, in which it is reduced to an impalpable powder; these mills running at high speed, heat the material to a degree warranting the use of metal elevators or conveyors and storage bins.

From these finishing mills, the flour is usually transferred by conveyors and elevators to the bolts or screens, from which the "tailings" return to the mills for re-grinding, and the screened flour falls by gravity to storage bins over the cookers or calcining kettles. In some instances, however, the flour is carried from the mills as above described, to the bins over the cookers and from the latter passes to the bolts or screens after cooling.

The cookers or calcining kettles are iron or steel cylinders ⅜ of one inch in thickness, 8 to 10 feet in diameter, and the same in height; they are set on brick foundations over a furnace and enclosed in brickwork from 12 to 18 inches in thickness, the inner wall being fire-brick, an annular space being left between the brickwork and the shell of the cooker for the circulation of heat from the furnace. The flour from the storage bins above mentioned, is fed by gravity to the cookers (which of the size mentioned, have capacity for calcining about 3½ tons of ground gypsum per hour), where it is subjected to a heat of 230 deg. F. at which temperature it boils vigorously, giving off water vapor, which rises through the venting stack to the outer air.

The flour is stirred or agitated during the period of cooking, by a rotating arm having pendant lugs or arms which keep the flour in constant motion. When the temperature of the flour reaches 270 deg. F. the mass settles down almost solid and ceases to evolve steam, and when the temperature rises to 280 to 290 deg. F., violent ebullition sets in, the boiling flour often being thrown over the top of the kettle; when the temperature reaches 350-370 deg. F. the mass is ready for withdrawal through gates at the bottom of the kettle, into a cooling pit or bin, constructed of fire-brick or cement, where it is supposed to remain until sufficiently cooled for transfer by conveyor to finished stock bins as plaster of Paris.

From these bins the material is conveyed to various other bins, if as plaster of Paris, to the warehouses where it is bagged or barrelled; if as wall plaster or retarded plaster,

to the mixing device, thence bagged or barrelled or stored. It may be noted here that if the gypsum is to be converted into land plaster, it goes from the mills to warehouse without being cooked or calcined.

Retardents are used to delay the "setting" of the plaster in the proportion of about six pounds to the ton, being added at the mixer, the material presenting no hazard.

Wall plaster is prepared by adding animal (hair) or vegetable (wood) fibre to the plaster of Paris at the mixing machine, the operation creating no notable hazard, but the storage of the fibre inside of the mill structure should be restricted to a day's supply at most.

Hard wall plaster is produced by adding to the plaster of Paris various materials such as sand, marl, fire-clay, etc., in addition to a retarder, the mixing being without notable hazard.

Alabastine; anti-kalsomine, Lieno; cold-water paint and like wall finishing or surfacing material is produced from the finer grades of gypsum, which after having passed through the processes above described, is reground and repeatedly bolted or screened to reduce it to an extremely fine powder; it is then mixed with powdered dry metallic colors and glue, which has been ground to powder in a dry state, the mixture being finished by cooking in steam heated open top revolving metal pans, from which it is conveyed to cooling bins and from thence to the packing room, where it is usually put up in five-pound paper packages and shipped in barrels or crates of wood.

HAZARDS

Rock Dryers present the hazard usual to heat producing devices, and should be located at a safe distance from woodwork or other combustibles; the enclosing brick wall should be free from cracks and be supported by iron back stays; smokestacks should have proper clearance at roof passage. As a preference, dryers should be located apart from the main buildings.

Rock Crushers and crackers present no points of hazard requiring particular note.

Buhr Mills present only a mild hazard in operation, but the stones may be set so close or be speeded so high as to heat the product to an appreciable degree, hence all conveyors, elevators, casings and storage bins for the flour, should be of metal.

Emery Mills; the grinding faces of this class of mill are made of a very hard emery rock and operate in a vertical position at high speed, which tends to so materially heat the product as to emphasize the necessity for iron casings to conveyors and elevators, and fireproof storage bins for the flour produced.

Sand Dryers are usually heated by direct coal fires, and are not infrequently of improvised or makeshift character, but in any case proper protection against exposed woodwork or other combustibles should be insisted upon. From the fact that sand from the dryer retains its heat for a long time after removal from the device, it should always be stowed in metal or other non-combustible receptacles, and in transit to such deposit should pass only through iron cased conveyors or elevators.

Sand Grinding Mills present hazards similar to those noted regarding Emery mills, and the same precautions there noted apply here.

Bolts and Screens are slow motioned devices and present practically no hazard in operation, though fires have been known to occur in them when incased in wood and the flour from the cooker comes to them before having been properly cooled.

Cooker or calcining kettles; this device is a heat producer of note, hence the nature of its construction and environment should be such as to avoid possible over-heating or ignition of exposed woodwork, precautions such as noted relative to rock dryers being in order. A superior method of construction for this class of device was seen, where the ordinary 18-inch brick wall surrounding the kettle was re-inforced by a boiler iron shell, set at a distance of 6 or 8 inches from the brickwork and the intervening annular space filled with wet plaster of Paris; all woodwork near these kettles being cut away 8 to 10 inches, with their exposed surfaces covered with plaster board, each kettle having a brick, cement-lined cooling pit attached, an exceptionally good and satisfactory arrangement.

Cooling pit to cooker should not only be of fireproof construction, but should also expose no woodwork, while the casing of conveyors and elevators handling the flour should be of iron leading to a fireproof storage bin, as many fires have originated from carelessly transferring hot flour through wooden devices to wooden storage bins, this being the principal cause of fires in the class.

Plaster Mixers present only a mild hazard in operation, negligible.

Fibre Machines operating on wood are similar in hazard to excelsior machines, the material being produced by means of toothed saws set spirally on a horizontal cylinder operated by power, a log of wood first denuded of its bark, being held against the saws until it is reduced to shreds. These machines should not be located inside of the main plant, and the shredded material kept inside the plant should be limited to one day's supply, as it rapidly dries out and is inflammable.

Fibre Machines working on animal hair are devices similar to the "lumper" used in mixed mills for opening lumpy stock; they are however, smaller, and are usually operated by hand, though sometimes by power; they create much combustible dust in operation, and the opened, broken fibre is usually delivered on the floor, or into an open wooden box at the device. Should be located in separate enclosure, or preferably, outside of main structures, and the material be limited to one day's supply at the mixer.

Retarders when used as a commercial product, made outside of the premises, present a negligible hazard. As most of the retarders are patented compounds of secret ingredients, it will seldom be found that they are manufactured at the plaster mills, hence discussion of the process will be omitted.

Alabastine, Anti-kalsomine, etc., is but a refinement of plaster of Paris, as noted above, leaving out the hazard of the cooking kettles, the substitution of which by the steam pan cookers presenting a mild hazard.

CONCLUSION

Taken as a class, the average plaster mill is not attractive in appearance, nor entirely satisfactory as to construction, in both of which respects there is much room for profitable improvement. The business is rapidly growing in importance and it may be expected that the number of plants will increase in proportion to the demand for the material, thus providing a sufficiently large aggregation of risks to promise an average of experience in the class, the general hazard of which places such plants on same level as natural (Rosendale) cement works and modern lime kiln works.

Yours very truly,

F. M. Griswold

General Inspector

THE CHLORATES

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The Chlorates

Interpreting the provisions of a recently enacted law covering the matter of "Regulating the Manufacturing, Distribution, Storage, Use, or Possession of Explosives and Their Ingredients," the United States Bureau of Mines classifies as an "explosive ingredient"

> "Any chemical compound or mechanical mixture that contains any oxidizing or combustible units or their ingredients, in such proportions, quantities or packing that the ignition by fire, friction, or by concussion, by percussion, or by detonation of, or any part of the compound or mixture may cause such a sudden generation of highly heated gases that the resultant gaseous pressures are capable of producing destructive effects on contiguous objects, or the destroying of life or limb,"

and specifically nominates as coming under this category the chlorates of barium, potassium, sodium and strontium, each of which is liable to ignition and explosion under any of the conditions mentioned, and as an additional precaution, the law (Sec. 5) provides, "no person shall have in his possession, or purchase, accept, receive, sell, give, barter or otherwise dispose of or procure explosives or ingredients, except as provided in this act."

Attention is called to the enactment of this stringent and restrictive law in order to awaken a wider and more appreciative interest in guarding against the hazards brought about by the present necessity for the production of high explosives to meet the ever increasing need for the prosecution of the present world-wide war, which has compelled a vast increase in the production of their basic ingredients, notably in relation to chlorates and nitrates, with the result that these basic compounds are being accumulated and stored in very large quantities at various points throughout the country, in many instances without discrimination as to locality or consideration as to the possible jeopardy to life or property by fire and/or explosion which must exist where such dangerous compounds are stored and handled.

Past experience has frequently demonstrated the well known and dangerous instability of these compounds and their liability to bring about disaster under seemingly slight provocation, and recent fires and explosions due to their presence and handling serve to strongly emphasize the necessity for increased caution by those responsible for the storage and distribution of these materials.

While the hazards incident to the manufacture of chlorates may be considered as comparatively mild, this condition does not prevail in the matter of the finished product. All chlorates carry large percentages of loosely combined oxygen content, and while it is generally assumed that pure chlorates are not inherently of an explosive nature, they are known to become so when in contact with organic matter and other substances; when subjected to the influence of friction, shock (as in crushing the hard lumps), concussion and percussion, and when heated to about 400° C. (752° F.) through the liberation of oxygen, which sometimes occurs in a violently explosive manner.

Even, if by chance, explosion does not ensue from the ignition of the chlorate, the oxygen liberated serves to promote rapid combustion of contiguous organic matter and/or volatiles.

Chlorates are usually received from the factory packed in small hard-wood kegs, iron hooped and paper lined, and of a capacity of about 100 pounds each; observation as to methods of handling and storage evidences the fact that the weight of the package and the assumed rigidity of its construction serves to induce carelessness in handling, with the average result that the shock and jar due to rough usage develops defects in the package through which more or less of the material escapes and is scattered over the floor, thus presenting ideal conditions for ignition from its being mixed with dust from abraded floors, friction due to contact with workmen's shoes, or a shock due to the forceful deposit of the iron rimmed package into this mixture of wood dust and chlorate crystals serving perfectly to complete the mechanical combination productive of combustion.

In support of the statement that rough handling of chlorate packages is liable to cause ignition of the material, attention is called to the record of a fire and explosion which occurred at the Silver Spring Bleachery & Dye Works, Providence, R. I., February 19, 1896, where it is stated the explosion preceded the fire, being caused by friction set up through rolling or sliding the iron bound kegs of chlorate over loose crystals lying on the floor and in contact with accumulated dust particles; fire ensued and remaining kegs of chlorate are said to have successively exploded.

The recent fire and explosion in the Jarvis warehouse in Jersey City, N. J., was ascribed to the careless throwing of a lighted cigarette on crystals of chlorate scattered over the floor, and it has been assumed that the glowing end of the cigarette ignited the chlorate; while this conclusion may serve in lieu of a better one, it is most probable that in attempting to extinguish the cigarette with pressure from his foot, the workman set up just that amount of force and friction necessary to induce ignition through this mechanical

mixture of dust and chlorate crystals, and that continued effort to rub out the fire simply served to aggravate the conditions.

In support of the above explanation of the probable cause of the Jarvis warehouse fire in Jersey City, N. J., it is interesting to cite a fire of almost identical conditions, which is recorded as having occurred in the storehouse of Thompson, Son & Williams, Hulme, Manchester, England, in 1908, and reported in the *Chemist and Druggist,* of London, wherein it was stated:

> "It appears that the warehouse contained many tons of chlorate of sodium, chlorate of potassium and chlorate of barium, stored in barrels lined with paper."

Major Cooper-Key, Chief Inspector of Explosives, who made an investigation of the disaster, reported that "a laborer, in reaching a winch handle, jumped from a barrel and struck a spark with his boot, and then saw a flame. Rubbing the place with his foot only made the flame worse, and soon afterward three explosions occurred." The Chief Inspector says he is of the opinion that the fire was undoubtedly started or caused by the friction of the laborer's boot on a mixture of chlorate of sodium or potassium and organic dust on the floor of the warehouse, the presence of this mixture being proved beyond question by the rapid spread of the flame when rubbed with the foot.

In view of this conclusion, the Chief Inspector suggested that handlers of chlorates "should render chances of accident still more remote by precautionary measures, such as:

1. The elimination so far as may be possible, of combustible material in the packages containing chlorate.
2. The establishment of separate buildings, of fireproof construction, for the storage of chlorate.
3. Absolute cleanliness, i. e., the outside of the kegs, the floor and the walls of the store should be kept clear of all dust and dirt, and no one should enter the building in his ordinary boots. Either these should be taken off or 'overshoes' should be provided, as in a gunpowder magazine."

A proper observance and enforcement of these suggestions would serve to materially mitigate the dangers incident to handling these dangerous compounds under the general practice followed in the United States, but it should be borne in mind in addition to the danger of ignition by friction or other mechanical action, that an equal and important hazard exists where these chlorates are not so carefully segregated as to prevent accidental or careless admixture or contact with other substances which are not compatible with them, such for instance, as many organic substances of combustible nature, dangerous fluids, acids, acid producers and oxygen carriers.

Ready ignition and possible explosion may be produced by percussion when any of these chlorates "are mixed with such organic substances as sugar, meal, shellac, etc., and with charcoal, sulphur, or manganese dioxide (when warmed). With sulphuric acid; with potassium cyanide; with thiocyanates; with lead thiocyanate; with phosphorus, or antimony sulphide." (Von Schwartz.)

The disastrous fire and explosion at the Tarrant plant in New York City some years ago was ascribed to friction in handling raw chlorate, or in forming under mechanical pressure chlorate tablets containing sugar; a like fire and explosion occurred at the establishment of the Sharp & Dohme Co., in Baltimore, where chlorate tablets (known as Santonin Crystals), made from pure and clean material, were being compressed on a rotary machine which previously had been used for the production of hundreds of tons of like tablets without accident; in this case the operator of the machine, a man of ten years' experience in the making of such tablets, met his death through the rupture of the device.

A peculiar and interesting incident showing the extreme sensitiveness and instability of chlorate of potash is on record, where the provoking cause is attributed to mild friction between the tablets wrapped in paper and a penknife, carried together in the pocket of a man's clothing; supposedly, the jar incident to sitting down caused contact between the knife and the tablets, which became ignited and the man seriously burned before his clothing could be removed.

Chlorates are of great importance as bases in the manufacture of high explosives, and even where so apparently harmless a mixture as chlorate and sugar is made and subjected to a heat of 250° Fahrenheit it explodes with extreme violence. Commenting on the conclusions reached after an investigation of an explosion which occurred in the Pain's fireworks factory (England), the *Chemist and Druggist,* of London (1889), states, "Chlorate of potash is the most explosive substance met with which chemists and druggists have to deal. By itself it seldom gives rise to serious accident, but the violence of its character is occasionally shown." * * * "the results are of interest as corroborating previous observations regarding the highly sensitive nature to percussion and friction of chlorates to mixtures, particularly at slightly elevated temperatures. The chemicals employed in the manufacture of the stars were found to be chlorates of barium and potassium, nitrate of strontium, shellac, coal and charcoal." * * * "It was found, however, that one of the ingredients (Chertier's copper) of one of the stars was distinctly *acid,* and was the cause of the explosion."

When chlorates become ignited large volumes of oxygen are liberated which adds to the rapidity and intensity of the flame, and the heat thus generated is liable to raise the temperature of contiguous substances to the point at which their

volatile and combustible vapors or gases are freely given off and add to the intensity of combustion, and through combination with the oxygen, induce violent explosion; a like result would ensue through contact with charred or carbonized organic matter, such as wood, textile fabrics and the like falling into or upon the mass of heated chlorate; in support of this conclusion, reference is made to the very serious explosion which occurred as an "after effect of a fire" at the Kurtz's chemical works, St. Helen's, England, May, 1899, where, in an action for damages due to the explosion, it was "decided that chlorate of potash is a dangerous explosive in the presence of fire; perhaps from the gases emitted by the molten material in admixture with gases liberated by the combustion of other material in the vicinity."

Ingle (The Chemistry of Fire and Fire Prevention—1900), commenting on this explosion, states that the fire did not originate in the chlorate, "where over 150 tons were stored in a pure state * * * the explosion, which was excessively violent (it was heard 27 miles off), was due to the effect of heat upon the chlorate itself," or was the result of contact with oil of vitriol, "which was stored in large quantities near at hand." * * * "Potassium chlorate is endothermic, and if the temperature of a large quantity of it were suddenly raised the oxygen might be evolved explosively and the whole might then detonate."

F. M. Griswold

General Inspector

The Home Insurance Company, New York.

New York, April, 1918.

The Fire Hazards of Soft Coal

THE HOME INSURANCE COMPANY
NEW YORK

The Fire Hazards of Soft Coals*

The broadening use of soft coal for fuel purposes and in the recovery of its volatile by-products during the past few years has brought about its storage and accumulation in increasing quantities by railroads, distributors and large consumers at various localities throughout the country to such an extent as to produce conditions which bring under serious consideration the fire hazards incident to such accumulations, especially in relation to fires ascribable to spontaneous combustion, which, under ordinary conditions of storage, are almost certain to occur where some types of coal are stored in quantities, as has been markedly demonstrated during the winter of 1917-1918, by the frequency of fires in the dirty and mixed types of coal which came upon the market under the stress of war-time demands, and were stored without possibility of proper separation, thereby presenting conditions warranting an attempt to suggest some means or methods of fire prevention which may prove of value.

In 1903 THE HOME INSURANCE COMPANY of New York published for the information of its Agents a monograph on "Spontaneous Combustion of Soft Coal," in which the conclusions reached were based upon the results of investigations made by the author of this paper in relation to the causes of fires in the storage piles of soft coal then in use by various railroad companies, manufacturing plants and distributing centers, principally located in the eastern states, and in view of the fact that from a fairly general compliance with the suggestions for fire prevention then laid down, there was a marked decrease both in number and extent of fires in such accumulations, it is in the hope that even better results may be secured through a broader consideration of this important matter that this paper has been prepared as a supplement to the earlier study, bringing the subject more nearly up to date in the light of past experience and present knowledge, as developed through extended tests and experiments carried out during the past ten or more years by the technical staff of the Bureau of Mines and other accredited authorities, whose writings have become available through publication, and of which the author has freely availed himself in the preparation of this paper without in every instance citing the authority quoted.

* Includes semi-bituminous, bituminous and sub-bituminous coals and lignites.

Before taking up specific consideration of the fire hazards of soft coals, it is advisable to bring to notice that coal "is not a definite unit substance chemically, but is made up of a great variety of complex derivatives, various mixtures of which may show the same ultimate composition"; hence, while the value of chemical analysis as a basis for classifying the different kinds of coal remains open to doubt, a practical system of classification, based upon the physical differences of coals, has been adopted by the Geological Survey and the Bureau of Mines, which grades the various kinds or types of coal in the line of progressive stages of coal formation, rising from the younger and more volatile lignites to the older and more devolatilized semi-bituminous types; this system of classification is in general use in the United States and may be summarized as follows:

CLASSIFICATION OF COAL

Semi-bituminous—"Is of great commercial importance, but is not widely distributed. The centers of production are the Pocahontas and New River fields of Virginia and West Virginia, Georges Creek field of Maryland, Windber field of Pennsylvania, and the western end of the Arkansas field in the vicinity of Fort Smith."

Bituminous—"Is the most important grade in the country, and includes most of the coals east of the Rocky Mountains. In the western states there are large areas of bituminous coal," in Colorado, New Mexico, Utah, Washington and Wyoming.

Sub-bituminous—"The term 'sub-bituminous' has been adopted by the U. S. Geological Survey for what has generally been called 'black lignite,' * * * for the reason that the coal is not lignite in the sense of being woody. * * * It is generally distinguished from lignite by its color and freedom from apparent woody texture, and from bituminous coal by the slacking it undergoes when exposed to the weather. As the latter is an important difference in commercial use, it has been adopted by the Geological Survey as the criterion for the separation of sub-bituminous and bituminous coal."

Lignite—"The term 'lignite' is restricted to the coals that are distinctly brown and generally woody. They are intermediate in quality between peat and sub-bitumious coal." Lignite is abundant in Montana, the Dakotas and present in all of the Gulf States.

CAUSES OF SELF-IGNITION

Notwithstanding the many investigations, tests and experiments which have been undertaken to discover and explain the phenomenon of spontaneous heating of soft coal, the opinions and conclusions of expert authorities giving consideration to the problem appear to have gone no further than to agree that oxidation of some one or more of the elements of a coal compound is the prime cause, leaving still in doubt the important question as to which one or more of these elements, when combined with oxygen of the atmosphere, may, with any certainty, be ascribed the promotion of oxidation to such intensity and with such rapidity as to incite ignition.

It is held that "spontaneous heating of coal results, not from a self-contained ferment-like process within the coal, but from a slow oxidation of the coal substance or its mineral impurities by the ogygen of the air. Spontaneous heating cannot occur when air is excluded; * * * the first step in the oxidation of coal is the formation of an addition compound, or complex, of oxygen with one or more of the substances present in coal. This complex is unstable and decomposes readily, more readily in the case of some coals than of others."

There appears to be a practically unanimous consensus of opinion between the experts and the experienced handlers of soft coals that whatever may be the elements of a coal compound which are variously credited with being promotive of spontaneous heating, such action is most surely promoted when coal is stored in finely comminuted condition, such as dust, slack or screenings, and when these "fines" are intimately mixed with larger sizes, owing to the fact that there is thus exposed a large surface to the action of the air, thus facilitating rapid oxidation.

While the chemical analysis of two or more coals may exhibit close approximation to similarity in their compounds, it does not necessarily follow that each will develop like qualities in relation to spontaneous heating under like conditions, but it seems fair to assume that where two or more coals reveal close similarity in content of certain elements which are quite generally supposed to act as heat promoters, they may be grouped as a class deserving special consideration in respect to such phenomena; while this assumption is in the nature of a generalization, it appears to be supported in some measure by the fact that a careful study of the many coal analyses published by the Geological Survey and the Bureau of Mines reveals a quite marked similarity between the compounds of coals of types not specifically credited with being "fiery" in character, and those of well recognized tendency to spontaneous heating, in which latter type the predominating elements appear to be the presence in combination of **moisture** in excess of 4%; **volatiles** of over 15%; **ash and impurities** in excess of 6%; **sulphur** above 2% and **oxygen** in excess of 7%; this combination being particularly noticeable in relation to all coals of a friable nature which have a tendency to disintegrate in "weathering" and are readily reduced to dust, slack or "fines" when not carefully handled in loading and unloading.

It is not intended to assert as an established fact that the combination of elements above noted will always prove a certain indication that any coal so constituted will develop "fiery" tendencies under any fixed conditions, as it is well known that in many instances "fiery" coals are found wherein any one or more of these compounds may differ in the

presence of its elements in largely reduced percentages of volatiles, sulphur and oxygen, such for instance, as the semi-bituminous coals of the Windber field of Pennsylvania, the Pocahontas and New River fields of Virginia and West Virginia, as also in some of the bituminous fields of western Kentucky, and many of the Missouri fields.

The fact that some combinations of certain elements which are common to all types of soft coals appear to be especially prominent in the make-up of coals of known "fiery" tendency, presents a condition of sufficient interest and importance to warrant more careful investigation and study in respect to what effect, and within what limits, the presence of these elements in a coal compound may, or may not have to do with the promotion of spontaneous heating.

Considering now the supposed causes of spontaneous heating of soft coals, the subject may best be treated by taking up in detail those elements, which, as before noted, seem to serve an active part in the stimulation of oxidation in coals of known "fiery" character or tendency.

Moisture—"The moisture in coal consists of (1) extraneous moisture (from external sources); (2) inherent moisture, which is one of the products of the original vegetable matter from which the coal is derived."

While it still remains a disputed question as to what effect the presence of moisture in coal may have on its liability to spontaneously heat, experience gained in the investigation of causes, where fire loss claims have been made, strongly supports the assumption that moisture **does** promote heating, with possible ignition, in some, if not in all types of soft coal; in further support of the conclusion, the following excerpt from a technical paper may prove of interest:—[1]

"Evidently the rates of oxidation of different coals are not effected uniformly by moisture." * * * "However, the opinion among coal shippers and consumers that there is more danger of spontaneous combustion during warm, wet weather than during dry may have another basis, the physical change brought about by wetting the coal on the surface of the pile. Such wetting reduces the proportion of voids or open spaces in the mass. If the coal is divided into particles fine enough, the water will fill the voids completely and be held there by capillary attraction. Such a mass of coal and water on any part of a pile would block the passage of air at that place. As a result the conditions of ventilation in the pile before the wetting would be changed so that, in some instances, the heat generated by the gradual oxidation of the coal would be retained until the temperature of ignition was reached." * * * "The conditions described have been approximated to a degree in many storage piles of coal. In these piles moisture had a decided influence in the production of spontaneous fire."

(1) Katz, S. H.—Porter, H. C.—"Effects of Moisture on the Spontaneous Heating of Stored Coal." Technical Paper 172, Bureau of Mines (1917).

Published records of coal fires show that some types of coal are so susceptible as to ignite when rained upon while in transit in open cars, and also when piled in the open; this result being especially notable in relation to the sensitiveness of slack or "fines" from bituminous coals of a friable nature, such for instance as Hocking Valley (Ohio); those from Iowa, southwestern Illinois, some localities in southwestern Kentucky, and particularly of the Bevier district of Missouri, which latter type appears to be even more susceptible to the action of moisture than are the sub-bituminous coals of the Sheridan district of Wyoming and the lignites of the West.

Coals showing a natural high moisture content "are low in the scale of coal formation, and consequently most susceptible to deterioration on exposure to atmospheric oxygen"; these types of coal appear to exhibit marked avidity for the absorption of additional moisture and oxygen. But it should be borne in mind that a large excess of moisture, approaching complete wetting, does not present the evil conditions accredited to that of simple moisture, and to the important fact that complete submergence under water is an absolute preventive of spontaneous combustion; in all probability, the only certainly known preventive of such action in any or all soft coals.

Volatiles—Consist "chiefly of the combustible gases, hydrogen, carbon monoxide, methane and other hydrocarbons and some non-combustible gases," but "does not signify a definite compound that was in the coal before it was heated. Different degrees or rates of heating will give more or less volatile matter." Coals high in volatile matter will, in a great many cases, be high in sulphur content, and "the rate of oxidizability varies approximately as the percentage of volatile matter."

What direct effect the presence of volatile matter may have in the promotion of spontaneous heating is as yet undecided, for, while it is admittedly true that the high volatile coals of the West are usually very liable to heat spontaneously, this property is said to be due to the chemical nature of their constituent substances rather than to the amount of volatile matter they contain; the presence of so-called "intrinsic" impurities appearing to play quite an important part in the promotion of such chemical reaction as to produce oxidation to the point of ignition.

In illustration of the present uncertainty as to the effect of volatile matter in relation to the heating of coal, it may be stated that the Bureau of Mines[2] reports as the result of its investigations that "appalachian coals, with 17% to 21% of volatile matter, gave a great deal of trouble from spontaneous fires. Moreover, several large works report that their low-volatile coals are more troublesome in respect to spontaneous fires than their high-volatile gas coals," and

(2)—Porter, H. C., and Ovitz, F. K.—"Deterioration and Spontaneous Heating of Coal in Storage." Technical Paper No. 16, Bureau of Mines (1912).

that there is "no falling behind of the 'smokeless' type of coal in furnishing instances of spontaneous combustion, and no cause for placing especial confidence in this type of coal for safety in storage."

Ash—Represents the incombustible residue left from the complete combustion of the coal; it is derived from the inorganic matter in the coal, composed largely of compounds of silica, alumina, lime and iron, together with smaller quantities of magnesia, titanium and alkaline compounds.

Ash is considered as one of the "two great impurities" of coal (the other being oxygen), and is classed as being of negative and anticalorific value. The constituents of ash are variable and appear to conform to no known law in variation, and present conditions promotive of spontaneous heating apparently in proportion to their complexity. High ash content usually indicates high volatile and high oxygen content and in many cases also shows a high sulphur content.

Coals of unsorted, "mine run" type, and other coals from which incombustible matter has not been removed before piling have proven particularly susceptible to spontaneous heating.

Sulphur—"Occurs in coal as pyrite or 'marcasite,' as sulphate of iron, lime and aluminum, and in combination with the coal substance as organic compounds."

Pyritic sulphur may appear in coals as ordinary or yellow pyrite, technically classed as "mundic," or as white pyrite, specifically known as "marcasite"; the two kinds of pyrites often occur in combination or association; the white or marcasite variety is lower in specific gravity than the common or yellow pyrite, and is more liable to oxidation than is the yellow; the greater the proportion of marcasite the more liability to alteration in combination. Pyrite is found to be present in some coal beds in the form of balls, lenses and bands, and in others disseminated throughout the coal in finely comminuted particles or veinlets which are difficult, if not impossible, of removal by mechanical means.

The effect of sulphur on the spontaneous heating of coal has provoked much discussion and difference of opinion in the past, and appears to be still an unsettled question; many users and handlers of large quantities of soft coals appear to consider it as the prime incentive, and as particularly active when in a finely comminuted state and subjected to moisture, in which condition it is said to exhibit great avidity for oxygen, with consequent heat-producing reaction.

Notwithstanding the uncertainty attached to this question, many of the accredited authorities on coal fires give caution as to storage of coal showing high sulphur content, and rightly assume that it is safer to store only that with low content of that element; this conclusion appears to be amply justified through practical field experience in the

investigation of causes of coal fires, and also to be strongly supported by the record of frequent fires in the pyritiferous and carboniferous black slate common to the Menominee iron fields of the Lake Superior region, it being stated that "these black slates, if they contain sufficient pyrite and carbonaceous matter, ignite spontaneously when exposed to the air under certain conditions," and that fires in the crumpled, crushed and broken rock and slate piled at the mine dumps "seem to be of such common occurrence that it is seldom that a fire cannot be found in some part of the black slate dump."(1)

The investigator of these fires concludes that "a most important factor seems to be the presence of finely divided masses or crystals of pyrite intimately mixed with the carbonaceous matter and disseminated throughout the rock." Practically similar conditions prevail in the culm piles of the anthracite regions in Pennsylvania, where fires, supposedly due to the presence of pyrites, are of long record and observation, almost every culm pile constantly giving off hot vapors, steam and smoke from the mine refuse.

In further support of the contention that the oxidation of pyrites does result in the promotion of heating in coals and other carbonaceous matter, it is of interest to cite the occurrence of fires in the dark, soft shale and low-grade lignite formations of the Panama Canal Zone at Culebra Cut, where it was discovered that the material removed from the bore-holes or by blasting, heated spontaneously on exposure to the atmosphere, even the interior of the bore-holes giving off heated vapors which deposited white and yellow flocculent matter on the surface of the bore. An investigation of the cause of this phenomenon resulted in the conclusion that heating was due to the presence of microscopic particles of pyrite in the mass, which on exposure to the air oxidized with sufficient energy to incite ignition of the carbonaceous matter of the shale and lignite, "the mainspring of action here, then, as in other instances observed, has undoubtedly been the oxidation of the pyrites."(2)

Oxygen—Is classed as one of the great impurities in coal, and as of negative or anti-calorific value in relation to the efficiency of coal as fuel.

Oxygen is the active principle in support of combustion which may be set up by oxidation of the coal substance or its mineral impurities, the rate of oxidation showing wide variation between different classes of coal, generally in close conformity with the known variations in inflammability and ease of ignition, as well as in their tendency to deteriorate

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(1) Higgins, Edwin.—"Fires in Lake Superior Iron Mines." Technical Paper No. 59, Bureau of Mines (1913).

(2) McDonald, D. F.—"Some Engineering Problems of the Panama Canal, &c." Bulletin 86, Bureau of Mines (1915).

or to become heated spontaneously when exposed to the air. Freshly mined coal and the fresh surfaces of crushed coal take up oxygen readily when exposed to the air, and "strange as it may seem, the oxygen content of coal appears to bear a direct relation to the avidity with which coal absorbs oxygen; high oxygen coals absorb oxygen readily, and therefore have marked tendency to spontaneous combustion."(3)

A study of a large number of analyses of soft coal develops the interesting fact that in almost every instance a high oxygen content is accompanied by high **moisture,** and in many cases this condition is supplemented by high **volatile** and **ash,** with **sulphur** content varying from very low to very high, with an average of about 60% of the analyses examined showing an excess of sulphur above the 2% limit assumed to indicate the danger point for spontaneous combustion, thus, in a measure at least, supporting the contention set forth that in some combination of these specified elements is to be found the probable cause for the notably "fiery" nature of some types of soft coals, and it may possibly be found that in this view of the subject there is sufficient merit to warrant further study and investigation by those fitted and equipped for the task, to the end that the many conflicting theories and differences of opinion now advanced in attempted solution of this important problem may be displaced by more definite and authoritative conclusions.

In summary of what may be termed the "inherent" causes influencing the spontaneous ignition of soft coal, it seems fair to say that the consensus of both lay and expert opinion is more or less in general accord with the following conclusions:

1—That practically all soft coals and lignites are subject to ignite spontaneously, under favorable but widely differing conditions.

2—That spontaneous heating of coal is due to the slow absorption of oxygen from the air at normal temperatures, and that heat stimulates oxidation.

3—That oxidation is self-propagating, producing heat even in its initial stages, reaching the point of ignition if its heat is not dissipated as rapidly as it is generated; the greater the surface exposed to the air, the more rapid the oxidation.

4—That finely comminuted coal (screenings, slack and dust) oxidizes more readily than lump or screened coal, the conditions being aggravated by the presence of natural impurities and extraneous matter.

5—That spontaneous combustion cannot occur when air is excluded.

6—That no one element of a coal compound has been agreed upon as that solely responsible for spontaneous ignition by reason of its avidity for oxygen.

7—That moisture promotes oxidation and heat producing reaction.

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(3) Porter, H. C.—Ovitz, F. K. "Deterioration and Spontaneous Heating of Coal in Storage." Technical Paper No. 16, Bureau of Mines (1912).

8—That ash-producing elements aid oxidation in proportion to their complexity.

9—That sulphur (as pyrites) is an active element promoting oxidation.

10—That high oxygen content usually indicates a readily friable coal, and also the probable presence of other elements stimulative of spontaneous ignition.

11—That in some undetermined percentage, moisture, volatiles, ash, sulphur and oxygen, as constituents of the coal compound, may each, or in some uncertain combination incite combustion.

Supplementing this resume of what may be termed as the "inherent" causes of spontaneous heating of coal, it is well to realize that heat-producing reaction may be induced and accelerated by the physical condition of the coal, when, and as, piled under general practice, hence, this combination of hazards seems to warrant consideration and treatment by bringing into correlation the several and complex inherent and physical properties in such manner as to indicate the proper precautions for observation as a means of minimizing the occurrence of fire, and to suggest the methods to be pursued in fire prevention and fire extinction, in such manner as may prove to be worthy of acceptance by those who desire to protect themselves from the vexation, worry and expense incident to coal fires, whether insured or not insured.

The following suggestions are presented under a full appreciation of the fact that they may not secure general and unquestioned acceptance in every instance, nor that they will prove of equal value under all conditions of storage usual and necessary in practice, as the adoption of these precautions might in some cases prove to be difficult of accomplishment because of physical conditions or by reason of the expense incident to full compliance, but at the same time, the writer is confident that where these suggestions are properly complied with, there will result a freedom from fire troubles fully warranting the effort and expense incurred in providing the method and system herewith submitted.

SUGGESTIONS

(1)—Avoid piling in excess of twelve (12′) feet in height and of more than 1500 tons in volume in any one mass. Trim piles in such manner that no point within its interior will be more than ten (10′) feet from an air cooled surface. Maintain a clear and open space of at least five (5′) feet between the base lines of each pile in order to facilitate handling and to prevent spread of fire.

Large masses of coal prevent the dissipation of incipient heat due to slow oxidation, and also present physical difficulties in handling and removal in case ignition occurs.

(2)—If possible, store only clean, screened lump coal; if space permits it is advisable to pile separately the different sizes.

Some accredited authorities hold that storing sized lump coal insures such free circulation of air through the mass as to carry off incipient heat as generated, and thus to permit its indefinite storage without danger of heating, but this

contention does not appear to be generally accepted, as field practice develops enough exceptions to warrant close supervision of such piles to discover tendency to heat.

(3)—Readily friable coals (usually those showing both high moisture and oxygen content), should be stored in closely compacted piles of both small area and height, entirely separated from other piles by a clear, open space of at least five (5′) feet between base lines, and be subjected to frequent tests and close observation to discover tendency to heat.

Friable coals absorb both oxygen and moisture with avidity, and frequently ignite spontaneously on exposure to the air; some types of bituminous, and practically all types of sub-bituminous coals and lignites suffer degradation upon exposure to the air and the elements; some types igniting spontaneously when rained upon in transit or when piled in the open.

(4)—Prevent the production and accumulation of dust or "fines" through breakage which results from dropping the coal from "grab-buckets" or other means of deposit at excessive heights and by too frequently handling. The large surface exposed by accumulation of dust or "fines" promotes rapid oxidation.

(5)—Avoid alternate stratification of "fines" and coarse coal in the pile; such disposition prevents circulation of air through the mass and facilitates oxidation of the dust, retarding the dissipation of heat thus generated. If necessary to pile unscreened coal, care should be taken to intermix the coarse and the fines as evenly as possible throughout the mass.

(6)—Storage of dirty, unscreened coal, such as "run-of-mine," or that showing an undue content of incombustible matter, common to the practice under "war time" pressure has proven to be dangerous as a fire-breeder. Such coal should be stored in separated, low piles of small volume, and be frequently tested for evidences of heating.

(7)—Storage of mixed types of coal in same pile or bin, as in some instances became necessary under the rulings and practice of the U. S. Fuel Administration in the adoption of its pooling system, has proven a dangerous practice, causing many spontaneous fires, presumably due to the presence of coals of a fiery nature provoking the ignition of those less susceptible to such action.

(8)—Storage of wet coal, or the wetting of coal in a pile, serves to promote active oxidation; repeated wetting and drying of coal aggravates this condition. Wet coal should be used up at once, if possible, or be spread out to become dry before being added to a pile.

(9)—Coal stored in such manner as to surround or be in contact with wooden posts, trestle supports or other irregular surfaces enveloping the mass, and/or on porous bottoms, such as coarse cinders and the like, provides interstices or channels facilitating the entrance of air to the mass in sufficient volume to induce slow oxidation at points of contact; in many coal fires the seat of initial ignition has been definitely located at such points.

(10)—Avoid attempts at the artificial ventilation of the interior of a coal pile by the use of iron pipes (perforated or not), wooden or other flues and the like, as experiments of this character have generally proven to be more harmful than otherwise, owing to the passage of air around these devices in sufficient quantity to set up slow oxidation, but too small in volume to carry off the heat thus generated.

(11)—Where coal is stored under cover or in an enclosed structure, free circulation of air should be provided in order to carry off methane and other gases escaping from the coal, and thus prevent its ignition and explosion on contact with incandescent masses of coal, or from other causes.

(12)—Avoid piling coal in contact with boiler or furnace walls, against or close to steam pipes, hot air flues or other external sources of heat. Heat stimulates oxidation in proportion to the increase in temperature.

(13)—When coals of known or suspected "fiery" type must be kept in stock, make the piles as small in volume and low in height as may be practicable, storing screenings separately if possible. Keep under close supervision to detect heating, making frequent rod or other tests, and maintain a clear, open space of not less than five (5′) feet between bases of piles.

(14)—Screenings, slack and "fines" from practically all types of soft coal are so susceptible to spontaneous heating as to be classified with known fiery types, and should be piled in as small volume as practicable, low in height and closely compacted in a mass, and be under close observation for heat, with a clear, open space of five (5′) feet between bases.

(15)—When possible, it is best to select for storage that type of coal which shows a low sulphur (pyrite-marcasite) content. Where high pyritic coal must be stored it should be screened and formed into low piles of small volume, properly separated from other accumulations, and be kept as free from moisture as may be possible, with close supervision and frequent tests for evidence of heating. Screenings and fines from this type are usually very susceptible to oxidation when moist or wet, and should be piled separately in low compacted mass, and be kept under close observation for symptoms of heating.

(16)—All piles of coal should be frequently tested to discover indications of heating, preferably by driving iron rods into the mass at various locations, letting them remain in place for a sufficient length of time to absorb such heat as may be present. If on removal of the rod it develops heat enough to prove painful when held in the naked hand (say 160° Fah.), it becomes evident that incipient combustion has been set up, demanding prompt attention to prevent an actual outbreak of fire.

(17)—The only absolute preventive of spontaneous combustion in any type of soft coal is that of its storage under water, thus entirely preventing access of air. Submerged storage is an expensive method of preventing heating and combustion, not in frequent use in practice except where large quantities of known "fiery" coals are to be kept for long periods of time.

It should, however, be borne in mind that any coal superimposed upon the submerged portion and exposed to the air, is liable to become heated through absorption of moisture from its submerged base.

FIRE EXTINGUISHMENT

While it is an essential precaution to always maintain a large and reliable supply of water under adequate pressure, supplemented by the provision of hydrants, hose and other suitable fire fighting apparatus for the general protection of any plant where large accumulations of coal are stored, it is unfortunately true that the use of water as a means of extinguishing coal fires is not of general approval by those experienced in the storage and handling of soft coals, as under the best of conditions its use

for that purpose is more liable to prove harmful than beneficial. Unless water can be applied directly at the seat of a fire at its incipiency, and in such volume as to completely drown out combustion by cooling the heated mass to a degree of temperature below that of its ignition point, its use in less volume would materially aggravate the trouble by closing the interstices through which the heat of combustion might find means of escape.

Practical experience in field practice of handling coal fires demonstrates the fact that where coal is piled not in excess of twelve (12′) feet in height, nor more than 1,500 tons in volume that the most expeditious and satisfactory method of controlling a fire after its position in the pile has been definitely located, is to break into the top of the pile and channel down to the seat of heating, removing the affected portion and spreading it upon the ground, in piles not over two feet in height if combustion has not reached the stage of incandescence, so that it may gradually cool off by air circulation; if the mass is aglow, it should be spread out thin and be quenched with water.

The salvaged coal should be used up at once or be otherwise disposed of without being returned to the pile. The proper handling of coal under this method has long been practiced by several of the leading railroad companies of the country with satisfactory results, notably where proper provision and use of suitable mechanical means and appliances have facilitated the rapid handling and transfer of the coal when necessary.

In conclusion it may be said that the very essence of safety from fire in coal is that of constant watchfulness and intelligent supervision to discover at its incipiency any tendency to heat, followed by prompt and efficient action in locating and extinguishing any sign of ignition before it spreads to larger proportions. Safety will be further insured through the selection and storage of as high grade as possible, and by adherence to accepted good practice in methods of storage and handling.

This paper having been prepared and published for the information and guidance of our Agents under whose supervision may come the opportunity to accept or reject liability on coal in storage, it is assumed that the matter covered and the suggestions as to fire hazard and fire prevention herein presented may prove a sufficient guide to insure intelligent inspection of the conditions found to exist in any case, and that all reports of inspection will specifically cover the salient points as indicated, and include, where possible, specific information as to the locality or district and mine from which the coal was secured, as also, at what season of the year coal is usually stocked, in order to enable the home office to reach an intelligent conclusion as to final acceptance of the proffered hazard.

F. M. Griswold

General Inspector

New York, December, 1918.

Fire Prevention
and
Fire Protection

For Manufacturing Plants

BY

F. M. GRISWOLD
General Inspector

THE HOME INSURANCE COMPANY
NEW YORK

*Fire Prevention and Fire Protection for Manufacturing Plants

By F. M. Griswold, G. I.

Gentlemen:

Let me assure you that I very highly appreciate the privilege of addressing an assemblage of this character, realizing that I have before me men of more than ordinary intelligence, whose study under capable instructors has prepared them to readily grasp the importance of fire prevention and fire protection as applied to manufacturing plants as an essential element in plant-design, and who are therefore mentally fitted to assimilate the techinal and practical features embodied in that new branch of science known as "Fire Protection Engineering," a knowledge of which is in my opinion, a necessity in the proper rounding out of the technical equipment of these young men who are about to venture into the field of endeavor and accomplishment for which they have prepared themselves, and wherein the opportunity for reward and honors is limited only by the capacity of those who strive.

In view of the recent establishment of a department in your University covering the science of "Fire Protection," I fear that it may not be possible for me to tell you very much with which you are not somewhat familiar through the course of lectures which have already been delivered on the subject; however, in a matter of such broad scope and transcendent importance to the welfare of the individual and to the nation as a whole, iteration and reiteration is not only excusable, but is a necessity, born of the fearful toll which the people of this country are paying on account of the ravages of fire, which is yearly dissipating hundreds of millions dollars of the values vested in our created resources, for the conservation of which the public conscience needs to

*Lecture delivered to Fourth Year Class on Manufacturing Plant-design, Columbia University, 9th May, 1911.

be awakened to a proper sense of the responsibility which rests upon each individual to personally endeavor to check this needless waste of both life and property, which is the result of selfish carelessness and indifference in relation to prevention measures.

I trust therefore that you will pardon me if I say a few words on the subject of the fire waste in this country, before giving attention to more specific matters relative to fire prevention and fire protection as applied to manufacturing plants. Assuming that each of those within reach of my voice is more or less familiar with the activities of the officials of the general government in relation to the conservation of the natural resources of our country, and that most of you are ready to commend and encourage this somewhat tardy effort to husband the bounties which nature has so kindly provided and which we have heretofore so prodigally wasted, let me ask, how many of you have taken seriously to heart the almost criminally inexcusable dissipation of the created resources, the actual invested wealth of this country, which for each year, and for many years past, has been absolutely eliminated from the assets of the nation, as a needless sacrifice to the demon fire?

Fortunately nature may, and frequently does restore the waste of its values which man permits or instigates, but when man permits or instigates the waste of acquired wealth by fire, it means an absolute and irrevocable destruction of so much accumulated value; fire resolves the combustible into its original elements, which man cannot re-assemble into an entity as an evidence of his capacity for creating resources, nor can he count these intangible elements as part of his assets, hence, he who would retain that which has been accumulated, must be his own conservator and forfend the day of obliteration of his holdings by constant and unceasing effort to prevent fire, and supplement such effort by the provision of reliable and efficient fire protection.

In order to impress upon your minds the enormity of the fire waste in this country, with its accompanying sacrifice of human life and injury to person, let me epitomize the statistics of many years into an average one year period as follows:

During one year (1907) fire caused the death of 1,449 persons and the injury of 5,654, according to statistics gathered by the U. S. Geological Survey.

Each year since shows an increasing loss of life and record of injuries, the human sacrifice keeping pace with increasing fire waste.

Each year $250,000,000 of tangible value is wasted by fire.

Each minute of each day of the year sees $500 in value rising in flame and smoke leaving an ash-pile as its pyre.

Each year the fire loss equals $2.65 per capita of our 95,000,000 of population.

Each year this needless loss equals a tax of $13.00 per each family of five of our population.

Each year shows a record of 40 fires to each 10,000 of our population.

This, gentlemen, is a very brief statement; there are only five items in it, but it serves to brand the American people as the most prodigally wasteful of all civilized communities in relation to the conservation of their acquired resources. When we compare this shameful record with that of the nations of Continental Europe in respect to fire waste which we find as collated in a report of the United States Geological Survey, covering statistics of six leading foreign countries including cities having population comparable with a like number of the leading cities of this country, it is discovered that only eight fires to each 10,000 population take place each year, and that the fire loss in the same period is but 33 cents per capita in the cities, and but 48 cents per capita as a general average over all; assuredly, under these conditions the American people have no occasion to "point with pride" to their record.

In attempting to answer the natural inquiry as to the cause of the lower fire waste in foreign countries as compared with the experience with our own, it may be stated that under the centralized forms of government peculiar to these older countries, the individual is held to strict personal responsibility not only for fires occurring within his own property, but also for any damage to his neighbors on account of fire which is the result of violation of law, or in consequence of culpable carelessness, and may not recover payment for loss until after judicial investigation has proven him not at fault; the same conditions exist in relation to the tenant in whose occupancy fire may take place.

In addition to thus placing personal responsibility upon both the owner and the tenant, these governments formulate and enforce wise building laws and regulate the hazards of occupancy with such strictness that an evasion of either condition is almost unknown, while in this free country, every man assumes to be a power in himself, having little regard for the rights of his neighbors, and generally construing the term "liberty" into that of broad license to do as he pleases with his own, with the direful result evidenced in our yearly ash heap.

While it is perhaps beyond the bounds of hope to secure in this country as close official supervision of the individual as is had abroad, I confess to a desire for just that modicum of paternalism which would serve to take care of the fools, guide the ignorant, caution the reckless and severely punish the vicious when responsible for preventable fires. Certainly if we are to hope for a reduction in our fire waste, it must be sought in making the individual realize his personal

responsibility not only for the proper care of his own holdings, but also as an obligation to his neighbors and for the welfare of the nation in the matter of fire prevention.

It is a truism to state that communities are formed by the aggregation of individual units, but it seems wise to impress upon you a realization of the fact, that if the unit can be brought into appreciation of its obligation to prevent fires, the benefit to the community as a whole will soon become apparent, and herein, it appears to me, is opened to you a field of education of the unit both by precept and example, for the cultivation of which your technical knowledge so exactly fits you, and I trust you will appreciate their importance and grasp the opportunity whenever and wherever it may come to you so to do.

Passing now to the matters of fire prevention and fire protection, I am confronted with such a mass of essential detail in the proper consideration of each subject as to almost despair of being able to convey to you a proper conception of their importance within the time allotted for my remarks, but in general may say that FIRE PREVENTION covers such a wide scope as to compel special consideration as to methods for each plant as it comes under observation, no two being so alike in their needs as to permit generalization relating to details, but as the very foundation of fire protection is based upon the completeness and efficiency of fire prevention, this latter phase of the question will first be given attention, and in this relation it may be said that the most important and basic element in fire prevention is included in the term "shop management," or in more homely terms, "GOOD HOUSE-KEEPING," which is an essential in fire prevention in every plant, whatever the nature of its occupancy, the character of its building construction or the completeness of its fire protection.

Acceptable practice in "GOOD HOUSE-KEEPING" demands strict compliance with the following prime essentials in fire prevention:

First, the enforcement of rules which will insure cleanliness throughout the plant as a matter of daily practice, not only as a means by which the possibility of fire may be avoided, but as of profit.

(*a*) Floor sweepings; greasy lunch papers, oily wiping waste, paint-rags and like material subject to spontaneous ignition, should be deposited in "Standard" safety cans suitable for their reception, the contents of which should be safely disposed of each night, preferably to be burned under the boiler.

Ashes should be kept only in metal receptacles; should be removed from building each night and not be deposited in contact with combustible structures or material.

(*b*) Working men's clothes and overalls, when not in use should be kept in ventilated metal closets or lockers not in contact with readily combustible material.

(*c*) Oily metal turnings or filings should not be permitted to accumulate on wooden floors or be held in combustible receptacles, nor should they be mixed with combustible materials.

(*d*) All combustible process waste and other refuse should be carefully disposed of by removal from the buildings at the close of each day's work, and be safely deposited in locations not endangering the plant in case of ignition of such refuse.

(*e*) Time should be allotted to operatives for cleaning machinery and disposing of oily wiping waste, and for the removal of combustible waste material prior to hour of closing shop for the day.

(*f*) All volatile and inflammable fluids should be kept in and used from "Standard" safety cans; not in excess of one day's supply of such should be kept inside of building at any time, and all unused portions should be removed to a place of safety outside of the plant at the close of the day's work.

(*g*) Heating systems should be installed in a safe manner and be kept in good condition; steam pipes should not be in contact with woodwork or other combustibles; hot air pipes or other heat conveying or producing devices should be carefully arranged to prevent overheating or ignition of combustibles.

(*h*) Open lights or flame of any character should be maintained in such position as to avoid ignition of combustibles; gas brackets should always be of the rigid pattern, preventing swinging.

(*i*) Open lights or flame of any character should never be permitted for use in the presence of inflammable or volatile materials, or where inflammable dust is liable to be present; incandescent electric lights in such localities should be vapor-proof and of the keyless socket pattern and enclosed in wire guards, with operating switch located in an apartment separated from the inflammables.

(*j*) The use of so-called "Parlor Matches" or their equivalent should be strictly prohibited in all parts of the plant. If matches must be used, only those lighting on the prepared surface of the containing box or receptacle should be permitted.

(*k*) The use of the incandescent electric current for lighting is the safest means of illumination, when the equipment is installed in strict conformity with the "National Electrical Code" and its integrity insured by proper supervision of the equipment.

(*l*) All specially hazardous and dangerous processes or devices which may serve to cause or promote fire, should, where possible, be carefully segregated and properly separated from communication with the plant in general, and also receive special consideration in relation to fire extinguishing appliances.

(*m*) Watchman's service should be maintained at all times when the plant is not in operation, and the record of service be shown on such mechanical device as will not permit evasion of duty; records should be examined and checked over, filed and dated each day.

(*n*) Discipline should be enforced and system be maintained by holding shop foreman or floor boss strictly responsible for the maintenance of established conditions, a written report covering these matters to be filed with manager each day.

In order to be assured of the best results from the careful observance of these "Good House-keeping" rules, it is necessary to give consideration to the matter of building construction, as the measure of efficiency in both fire prevention and fire protection is largely affected by the character of the structure, it being evident that a fire resistive building, having open and smooth interior surfaces, without concealed spaces and with the minimum of combustible material in construction and interior fittings, would call for a less elaborate system of fire protection and present smaller opportunity for dangerous accumulations than would be the case where, as in ordinary joist or light construction, the whole interior is readily combustible, hence, assuming to roughly outline the essentials which should have consideration in designing a factory plant, the following suggestions are presented:

(*a*) Wherever possible, fire resistive material should be used in construction, avoiding combustible floors, roofs and roof houses, interior trim and fittings.

(*b*) Avoid "pockets" or concealed spaces in floors and walls, which serve to collect and harbor shop refuse, waste, etc.

(*c*) Separation of areas into the smallest units practicable for the use to which they are to be assigned; divisions between sections to be formed by standard fire-walls having only such openings as may not be avoided, each of which should be protected by "Standard" automatic fire doors on each side of the separating fire-wall.

(*d*) All openings in side walls at the angles of adjoining sections and toward all exposing structures or accumulations of combustibles should be protected with "Standard" fire shutters, or, where the exposure is not serious, by wired glass in "Standard" metal frames; the

absence of proper protection at such openings facilitates the lateral spread of flame and thus promotes conflagration.

(*e*) Vertical openings through floors should be avoided, as they form channels for spread of flame from floor to floor with almost incredible rapidity, and present one of the most dangerous features to be found in modern construction from a fire prevention viewpoint.

(*f*) Elevators, stairways, belt and rope drive raceways, should be separated and enclosed in brick or fire resistive shafts, having "Standard" fireproof automatic doors at all openings to plant.

(*g*) Fire escapes should be constructed with fireproof stairways, enclosed in brick or fire resistive shafts rising above roof, with outside balconies having doors swinging outward from building and inward from balcony to stairway escape; no openings from shaft to the building to be permitted.

While under the present advanced state of the art of building construction there would seem to be no valid objection to demanding conformity to the suggestions above laid down in relation to new plants, it is probable that there will come under your supervision changes in the design of plants already established and located in buildings of less desirable construction, and in such cases it will become necessary to so change the conditions affecting the fire hazard and "good house-keeping" as to bring them as nearly as possible to this higher standard, and this may frequently be accomplished at moderate expense. Reference to the National Board of Fire Underwriters pamphlet covering "Uniform Requirements" relating to building construction, will doubtless prove of value in such instances.

Again treating of building construction in its broad sense, it may be well to attempt a short classification of various types of buildings in relation to their adaptability to best promote success in the efforts toward fire prevention and fire protection herein suggested:

First, may be considered standard fire resistive or the so-called fireproof construction which presents no easily ignitable surfaces, and should when properly constructed show no avoidable features which might serve to obstruct the fire protective devices.

The higher first cost of this class of construction is thoroughly justified through the fact that its term of life is practically unlimited, and the probable depreciation somewhere about one-ninth of one per cent. per annum.

The question as to which of two classes of fire resistive construction is the better lies between the steel frame skeleton enclosed with fireproof tile and that which is enclosed with reinforced concrete. In my judg-

ment, there is little to be said in favor of one over the other except from the fact that in reinforced concrete construction, it is an evidenced necessity to have expert control from the selection of the cement through all the processes until the concrete is set in its moulds, and this result is not easily obtainable with the ordinary class of employees available in construction.

Second, "Mill" or slow burning construction carries with it many features which are desirable in relation to the ready extinguishment of fire from the fact that while all of its interior construction may be combustible, the heavy plank floors and their supporting timbers offer no hidden spaces, nor are they readily attacked by flame. The cost of this class of construction over that of ordinary construction is justifiable by the fact that its lease of life is superior, and the cost of its up-keep is very small.

Third, ordinary or so-called joist construction is particularly objectionable from the fact that it presents the largest exposed area subject to ready ignition, and offers the most difficult problems in relation to fire prevention and fire protection. Its low cost is very materially offset by the expensive up-keep and the high rate of depreciation to which it is subject, ranging from 4 to 4½% per annum. It is, therefore, apparent that under the present condition of advanced ideas in building construction, the designer of new manufacturing plants should strenuously avoid the consideration of the ordinary or light joisted type of construction.

At this point it seems wise to make reference to the National Board Building Code which has been prepared under the advice and counsel of eminent architects and engineers throughout the country, and presents information which will prove of large value to all who may seek to secure the result of a concerted effort to regulate the construction of buildings throughout the country which will best serve to reduce the fire hazard.

In attempting to specifically designate the nature or character of fire extinguishing appliances best fitted for use in any manufacturing plant, we are confronted with conditions in relation to the character of building construction and the nature of its occupancy which may serve to influence, if not to indicate, the selection of the class of apparatus which will presumably best control the given situation. The choice of appliances for the purpose covers a wide range, measuring in efficiency from the humble cask and pail of water up to and including chemical extinguishers, stand-pipes and hose, fire pumps and hydrants under private control and water supply, and to be further extended to the full paid and organized fire department under municipal control, but as the efficiency of each of these devices and

methods depends on the unreliable factor of the human element to be on hand and to intelligently handle them in emergency, experience has taught us that only when in the hands of skilled firemen may there be hope of satisfactory results in the use of these devices, and while cheerfully admitting their value as auxiliary means of fire extinction, I desire to call your attention to a method or system of fire extinguishment which is neither controlled or influenced by the uncertainty of the human element, a device and system which is always and automatically prepared to put out a fire at the point and at the time of its occurrence, responding instantly to the extinguishment of the flame, the heat from which sets it in operation, and which is suitable for effective service in practically any class of structure and under any condition of possible fire hazard.

This device is known as THE AUTOMATIC SPRINKLER, and it has reached its present position of dependability as a fire extinguishing appliance through long years of study and experiment, the records showing that as far back as the year 1809 and again in the year 1812, patents were granted in England to Sir William Congreve, M. P., for "an apparatus for extinguishing fires which shall be called into action by the fire itself at its first breaking out, and which shall be brought to bear upon the precise part where the flames exist"; while the automatic operation of this ancient device depended upon the burning of a cord to release a weighted valve which was normally closed, the wording of the claim is nearly broad enough to cover the more perfected device of the present day equipment, and had this far sighted conception been supplemented by half as much energy in commercially forwarding the introduction and use of the device at that time as has been the case with similar apparatus during the past thirty years in this country, the saving of human lives and the preservation of property values from the ravages of fire incident to its use would have established a record astounding in its proportions, and highly creditable to progressive civilization.

While the desire to secure means of automatically controlling the spread of fire prompted many inventive minds to undertake the task after the death of the Congreve conception, nothing of public interest seems to have occurred until about 1852, when a system of perforated iron pipes was introduced for fire protection in some eastern cotton mills, the operation of which depended upon the opening of a valve at the outbreak of a fire, thus calling in the human element with all of its uncertainties as the actuating power, and while this class of extinguisher did some good service between the date of its inception up to about the year 1875, the damage from the widespread distribution of water beyond the exact seat of the flame proved to be as disastrous as that caused by the fire itself, and the perforated pipe was re-

placed by a series of individual sprinkler heads each having a cap attached to its extremity and held in place by a fusible metal solder of such composition as to fuse at a fixed temperature, thus releasing the cap and permitting the flow of the water; this was the invention of Henry S. Parmelee, a noted engineer of New Haven, Conn., and the first record of a fire being extinguished by this device dates back to February 12th, 1877, when the property of the American Linen Mills, at Fall River, Mass., was saved from destruction through the operation of the Parmelee sprinkler head.

Following this demonstration of the efficiency of the Parmelee automatic sprinkler as a fire extinguisher, the use of the device gradually extended, and the experience gained in the operation of same at a number of fires demonstrated that they were somewhat slow in action, owing to the fact that the fusible cap was in contact with the water of the system at all times, thus necessitating longer exposure to the action of heat to insure melting of the alloy and retarding the operation of the device; realizing the seriousness of this defect in the water-joint head, and using the Parmelee idea as a base, many attempts were made to produce a head or valve in which the fusible solder would be removed from water contact and yet permit the use of a seal to the outlet which would be water tight through the mechanical device of struts which would hold it in place until released by melting of the solder joint; many of these devices proved to be impracticable and unreliable in service and have passed into oblivion, but there still remains a number of these devices which have stood the test of time and have been perfected to such a degree of reliability and efficiency as to have become recognized standards, and of these it affords me great pleasure to be able, through the courtesy of the several manufacturers, to present for your examination and study a full set of each of the various types of automatic sprinklers which are now accepted as satisfactory under the rules and regulations of the National Board of Fire Underwriters, and for the presence of which, when properly installed, large rate concessions are usually granted.

In explaining the nature and functions of the automatic sprinkler, it may be well to say that while in the exhibit before you each of the various types shows differences in general design and in the location of the fusible joint, as well as in its form, the principle upon which each of these devices operates is identical, in that by the melting of the soldered joint which holds together the several parts of the strut or lever supporting the seal to the outlet of the valve or head, this supporting device falls apart, and the pressure of water forces the seal out of its place, and striking the distributing plate the water is sprayed over a floor space the diameter of which is proportionate to the height of the sprinkler head above the floor, and its volume is controlled by the head in

feet or pressure in pounds at which the water is supplied at the outlet of the device, ranging from 12 gallons per minute at 5 pounds pressure up to 58 gallons per minute at 100 pounds pressure, through the standard open waterway of one-half inch diameter common to each of these devices.

In each case the composition of the fusible alloy used is standardized to insure its melting and the separation of the parts which hold the water seal in place at fixed temperatures suited to varying conditions; in this exhibit, the head without color other than that of its composition, indicates the normal or "regular" fusible joint, which is intended to release at a temperature of approximately 160° Fahrenheit, the variations from this basis being indicated by the coloring of the sprinkler head, the white coated sprinkler indicating a melting or releasing temperature of 212, blue that of 286 and red that of 360° Fahrenheit respectively, thus enabling the inspector to decide on sight the appropriateness of the equipment in specially heated localities; the head, nearly black in color, is specially prepared with a composition called "coro-proof" which is intended to prevent corrosion of the parts due to the presence of acids or other corrosive elements in the factory, the melting point of this composition being such that its use is practically restricted to locations in which the temperature does not largely exceed that of 160° provided for the "regular" fusible joint.

In each of these devices the composition of the metal forming its body and other exposed parts is of such nature as to prevent oxidation, while the material composing the water seal of the valve is of various composition, but in each case, likewise non-corrodible, and at the same time of such character as to prevent adherence at its seat under the influence of continued pressure.

In addition to these devices which are designed to operate automatically at a given rise of temperature caused by fire inside of a structure, we also have here specimens of approved devices for use in protecting structures from attack by flames originating in other and exposing structures by the delivery of a volume of water against the outside walls, upon the cornice and over the fronts of the windows of the building to be protected, thus forming a water-curtain as a stop to the entrance of flame from the burning exposure. These devices are known as "open sprinklers," and having no seal at the valve outlet, they are not automatic in action, but depend upon the human element to render them effective by the operation of opening a valve at the base of the riser through which water is to be conveyed to the distributer, but even with this disadvantage, the open sprinkler has so often proven its worth as a reliable fire-stop as to warrant its introduction as a means of protection against exposure fires whenever it is possible to secure installation of such an equipment.

It may also be noted that the only difference between the open sprinkler used for wall and window protection, and that designed for application to cornices, lies in the shape of the water distributing table or plate, the design in each instance being that which has given the best results in actual practice at fires.

In concluding this description and exhibit of approved automatic sprinklers, it is well to relieve the minds of those who fear the happening of large water damage through the leakage of these devices under normal conditions of temperature, or from excess pressure; it may be stated that the minimum pressure at which a leak is excusable, is fixed at 250 pounds to the square inch, and the temperature at which the fusible link may melt is held at 160° in order to secure compliance with the National Board rules before approval of the device, and the record shows so few failures in these respects as to place the matter outside of serious consideration as an objection to the introduction of the automatic sprinkler as a means of certain and reliable protection.

Trusting that I may have made plain to you the details of construction and the intended operation of the automatic sprinkler, permit me to present a short statement of what, in actual experience, this very valuable extinguishing device has accomplished in putting out fires in practically all classes of structures, with almost any conceivable hazard of occupancy, and in all parts of the world since the device has reached that stage of perfection which has enabled its use to make the record:

From figures compiled by the General Fire Extinguisher Company it is shown that before the more general introduction of automatic sprinklers in factories, the average cost per fire was $7,361, while under automatic sprinkler protection the average cost per fire in 13,476 cases covered by their records, amounted to but $277.26 each.

Supplementing this, the record of Sprinklered risks fires compiled by the National Fire Protection Association, covering a period of some 14 years, shows that of 10,171 fires listed, 64.25% were entirely extinguished by the action of the sprinklers; that 30.59% were held in check to such an extent as to permit extinguishment by other means, thus presenting a grand total of 94.84% to the credit of the automatic sprinklers for successful operation in holding in check or totally extinguishing fires; the remaining 5.16% of the whole representing unsatisfactory operation of the device, the failures of which was caused either by a lack of proper water supply, serious defects in the equipment, or on account of the equipment being rendered inoperative through the cutting off of its water supply, accidentally, carelessly, or otherwise.

It may be of further interest to state from these records of the National Fire Protection Association, that 47.66% of these equipments secured their primary supply from public water service; 34.71% were supplied from gravity tanks; 14.38% operated under pressure tank supply; 6.19% were supplied by automatic steam fire pumps; automatically operated electric pumps and connections from public fire department steamers each served as primary supply to the extent of .01%.

Remarkable as is this record of success in controlling fire through the action of automatic sprinklers, it must not be assumed that there is no limitation to their power of accomplishment in fire extinguishment, as a reference to the figures above given will show that something over 30% of the fires were simply held in check by the sprinklers until other means of fighting the fire could be utilized, and this fact emphasizes the necessity for always being prepared for any untoward condition of the automatic equipment, by providing auxiliary means to control the flame when from any cause the sprinklers fail to completely extinguish it, for even with a perfectly satisfactory installation, we are often confronted with conditions due to accident or carelessness, which, for a time at least, may entirely or partially disable the equipment after it has gone into operation.

In view of the fact that you have at your command copies of the National Board of Fire Underwriters' rules and requirements covering the installation and equipment of an automatic sprinkler system, I will not burden you by a repetition of those rules, but will content myself by assuring you that when such equipment has been installed in conformity with the rules and requirements, and is kept in serviceable condition by proper supervision and care, the chance for its failure to promptly extinguish any fire in its incipiency is extremely rare, almost improbable; indeed, with proper water supply under necessary pressure behind the automatic sprinkler in almost any conceivable locality where the delivery of its spray is unobstructed, it will vindicate its past record as the most efficient fire fighting device ever conceived by the human mind; it is always in the right place at the right time, ready for any emergency and promptly performs its allotted function without dependence upon human aid or direction in its accomplishment.

I cannot dismiss consideration of the value of the automatic sprinkler as being compassed by its utilitarian qualifications as a fire extinguisher, but must call your attention to the fact that it is also a very potent element in the matter of saving life at the time of fire, as the promptness with which it acts in the delivery of water under the influence of heat, likewise serves as an alarm to the occupants of the

threatened structures, thus admonishing them to seek safety in due time, while they are at the same moment under a drenching shower from the sprinkler which will prevent ignition of their garments, or extinguish the flame if already in evidence.

I am thoroughly convinced, as are all who are familiar with the operation of the automatic sprinkler, that if the premises of the Triangle Waist Factory, which recently burned in this city, had been under such protection, there could not have been such terrible loss of life, even as the result of wild panic, and that it is more than probable that the fire would have been completely extinguished at its incipiency and without serious loss of property.

Before giving attention to the class or specific character of fire extinguishing devices which are now generally acceptable for that purpose, it is perhaps well to call attention to the fact that as a means of fire extinguishment no agent has been discovered which can replace water under pressure, and commonplace as is this knowledge, few of those who plan to use this agent seem to realize the fact that the force or pressure which serves to carry a stream to burning material is only of value when, in addition to this carrying power it includes sufficient volume to completely drown out combustion, by cutting off the supply of oxygen and cooling down the temperature of the burning material to a point below that at which it will normally ignite; force or power alone is of little value in a fire stream, hence, in planning a "layout" for fire protection, the first consideration should be given to securing a reliable and abundant water supply, and then to so design the equipment as to provide for the most effective pressure to insure the delivery of the required volume when and where needed.

In giving proper consideration to this matter of volume to be delivered, it is necessary to recall to your minds the fact that the loss of head due to friction in service pipes varies as the two-and-a-half power of the velocity; that doubling the diameter of the main quadruples its delivery capacity, and that a main which is supplied two ways or from both ends, has double the delivery capacity of one of like size when fed one way only; hence, it becomes evident that in order to secure the most reliable service, the water mains in any scheme and whatever the source of supply, should be laid in complete circuit and be of sufficient size to provide volume under such head or pressure as will insure the delivery of full fire streams at each outlet in service, with a loss of head not in excess of 10 to 12 pounds below the normal pressure.

A "standard fire stream" demands the delivery of not less than 250 gallons of water per minute through a 1⅛" smooth bore nozzle and to secure this volume it requires a pressure

of not less than 45 pounds to the square inch at the base of the nozzle, which will give approximately a reach of 63 feet horizontally and about 70 feet vertically.*

In considering the relative value of water supplies for fire extinguishing purposes, it is evident that a well designed public gravity system, having ample supply and pressure, should lead the list, but in the matter of supply for manufacturing plants remote from public service, the problem becomes one for special consideration in each case, with its solution dependent upon local conditions as to the source of supply and the means by which same may be best utilized, the essential point in any case being assurance of sufficient volume and reliability as to the continuance of supply under emergency demands; the quantity available at isolated plants should always be sufficient to fully serve all appliances for defence for a period of not less than one hour of continuous operation.

Private reservoirs of sufficient capacity and at an elevation to insure adequate pressure for fire service throughout the system would prove the most acceptable, but are difficult to secure and of infrequent occurrence.

An underground tank or cistern, or similar container above ground, when of suitable capacity and with means of replenishment, is a fairly satisfactory source of supply for use with steam or other power-driven pumps, when the lift is not in excess of twelve feet.

A rotary water power pump may take both its energy and supply from the head at the dam, if the supply is sufficient, but this class of pump is not always reliable for fire protection.

Elevated tanks of the ordinary class and at customary elevations and capacity, are of small value for fire streams from either the stand-pipes or from yard hydrants.

The question of economy as a result of the uninterrupted operation of a plant being one of decided importance in plant design, it is well to bear in mind that the enforced stoppage of work caused by the occurrence of fire would be materially mitigated, if in advance of that misfortune proper precaution were taken to provide adequate and reliable means of fire protection to supplement the other essentials of good housekeeping and safe construction, and while it is undoubtedly true that the most reliable class of protection is to be found in the presence of automatic sprinklers, there are other devices and appliances which will serve good purpose in fire extinguishment when used with intelligence and judgment in that emergency, but in order to secure from such devices the most satisfactory measure of efficiency in the time of need, it is necessary that both owners and employees in every manufacturing plant should become familiarized

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* The horizontal and vertical distances given are from experiments by Mr. John R. Freeman, *Transactions*, Am. Soc. C. E., Vol. XXI.

with the appliances provided for fire fighting, and that a selected few of the most apt and intelligent of the force be formed into a fire brigade which should be drilled in the use of the appliances with such frequency and method as to render them a reliable force for the protection of the plant when fire occurs, and this result may best be accomplished by assigning to each member his appropriate position and duty in service when called upon for action, as will be found more fully detailed in the National Board pamphlet covering the formation of private fire brigades, copies of which are now in your possession.

Let me here utter a caution as to over-confidence in the matter of the efficiency of any private fire prevention equipment, however complete may be the appliances, or however well disciplined the fire brigade; in every case, upon the discovery of a fire, first call the public fire department, and then make the most prompt and intelligent use of the private appliances at command, thus insuring the concentration of all available means to conquer the flame, before it reaches proportions which may render it uncontrolable by any effort.

In giving consideration to appliances and devices now in common use for fire protection and not automatic in operation, time will not permit the detailed description which it is properly entitled to, and in this respect you are again referred to the pamphlets issued by the National Board, in which rules and requirements are set forth as to the construction and proper use of these manually operated appliances, which may be briefly considered as follows:

Casks and Pails.—When properly located and supplied with water, these devices are of great value in the early stages of a fire, and if intelligently used, frequently prevent serious loss.

Chemical Extinguishers.—Like fire pails, these devices are of decided value when available, and have the advantage of enabling the operator to direct an efficient stream immediately upon the seat of combustion up to a distance of about 40 feet.

Vertical Pipes (Stand pipes).—When located in accessible positions and under proper head or pressure, with hose and nozzle attached, serve well in the control of more advanced fires, provided the operator retains control of his faculties sufficiently to "stay by" the appliance and intelligently direct the stream delivered.

No stand pipe less than three inches in diameter should be installed; having this diameter, it will supply two streams through two-inch hose with nozzles of ⅝ or ¾-inch diameter, and four streams with same sized nozzles, through 1½-inch hose. Stand pipes supplied from elevated tanks of usual capacity and at average elevations, are not of value for hose stream service.

Steam Jets.—Are sometimes quite efficient in suppressing fires in dry-rooms and other confined spaces; where used there should be ample boiler capacity behind them to insure volume of steam.

Sand Pails.—Dry, granular sand, freed from excess of clay or loam, forms a very efficient means of extinguishing fires in oils, varnish and other inflammable fluids by smothering the flame. A proper supply should be maintained, with a scoop for its distribution, in places where such inflammables are used or stored.

Steam Fire Pumps.—Are a very efficient means of fire protection when they are properly designed for the special purpose, and situated in a fireproof structure separated from the general plant, with independent and duplicate sources of steam supply, and have a water supply of sufficient capacity to insure continuous operation for a period of not less than one hour's duration at full capacity.

Ordinary trade pumps, while efficient for general service, are seldom reliable under the stress of fire demands.

Centrifugal or Turbine Pumps.—When these are designed especially for duty in fire service they promise to be of considerable value when properly located as to exposure and fitted with both steam and water supply required for the direct acting steam fire pump.

Electrical Pumps.—Special fire pumps operated by the electric current are coming into use to a considerable extent, and when properly designed and located, with two separated and reliable sources of supply for power, may be expected to do good service.

Rotary Pumps.—Water power rotary fire pumps when designed for the purpose are capable of rendering very good service under favorable conditions of power supply and location, but, as a rule, the best results are not obtainable, for the reason that the usual location of the device is in a wheel pit or other equally unaccessible spot difficult to reach in case of fire, and for the same reason is liable to be neglected as to inspection and up-keep.

Fire Hydrants.—Whether public or private, should conform in construction to the National Standard, with a barrel of not less than six (6″) inches in diameter, and be fed from a service main of not less than the same dimensions forming a complete circuit of the system, without dead ends, meter connections or other obstructions to the free flow of water, and be located at a distance of not less than 50 feet from the buildings to be protected.

Hose connections or outlets should be of the National Standard pattern, unless the city outlets differ from it, in which event the outlets on private equipment should conform to the latter.

Fire Hose.—This is an important item controlling the efficiency of fire streams where hose is used, from the fact that the loss of head due to friction in the passage of water through hose of the very best rubber lined quality (of 2½" size) amounts to about 14 pounds per hundred feet of hose, while with the ordinary quality of hose on the market and in use, such loss of head may reach 25 or more pounds per 100 feet.

Hose for use on hydrants and other devices supplying streams on the outside of buildings should be of not less than 2½" diameter, with nozzles of 1⅛-inch smooth bore pattern, while hose for use inside of a structure should preferably be not in excess of 2 inches in diameter with a ⅞-inch smooth nozzle, in order to insure quick and effective handling by novices.

Underground Piping.—Should be laid in complete circuit, and where the system is extensive, should be gridironed in order to secure circulation. Pipe sizes of less than 6 inches in diameter should not be permitted in any equipment. One steam fire engine connected to a six-inch service line will cut off supply to any other device in the same line of service.

In order to be assured of even an approximately satisfactory system for any individual plant, practically none of the appliances and devices above mentioned should be omitted, except in the matter of fire pump selection, where a choice may be had, and the presence of all such apparatus is deemed essential to supplement the protection to be expected from a properly installed automatic sprinkler system.

If the time allotted to me for delivery of this address would permit the effort, I might go somewhat into detail as to the principal causes of fires in manufacturing plants, but this subject is one with a very broad field of possibilities and of experience, hence, I must content myself by stating that as about 80% of all fires are due to carelessness, and that in the final analysis of the remaining 20% which is usually attributed to accident, close investigation would show that as about 80% of these so-called accidents are justly attributable to a lack of proper supervision of machines or devices and of process methods, we will have left but a small percentage which may be classed as entirely accidental and unpreventable, and a faithful adherence to the gospel of "Good House-keeping" would unquestionably prove the cure for even the supposedly unpreventable causes.

In concluding my remarks I desire to call your attention to the value of the text books, or "Rules and Requirements" published by the National Board of Fire Underwriters, covering the fire hazards and means of fire prevention or extinction, copies of each of which it has afforded me much pleasure to present to you, and to express the hope that they may

prove of service to you in your work of standardizing factory design in the matter of fire prevention and fire protection, and thus, by instruction and guidance, lead the unit of values into such comprehension of its importance to the conservation of the interests of the whole people of this country, as to show marked results in the reduction of the inexcusable fire waste, which, if unchecked, promises to certainly impoverish our people as a whole, and to you, young gentlemen, comes the call to "spread the gospel of conservation of our created resources," and I trust your response may be both earnest and successful.

Combination Heating and Ventilating Systems

THE HOME INSURANCE COMPANY
NEW YORK

Combination Heating and Ventilating Systems

The practice of combining heating and ventilating processes into a joint system is based upon that principle of physics which demonstrates the difference in gravity between cold (or foul) air and that of heated air; the former being the heavier tends to fall, while the latter from its lightness tends to rise, these differences in density serving to create currents of opposite direction, whereby the ascending current of heated air displaces the cold or foul air, which then falls to the level of the floor of any enclosed space, where from its density it would remain stratified unless displaced by agitation or by liberation through vents at its level. 9

Hence in all scientifically planned combined heating and ventilating systems where natural forces are utilized as means of operation, the vent ducts for the escape or removal of cold or foul air are located at the floor level of an enclosure, and when properly installed, insure successful accomplishment of the purpose intended, even if in arrangement and construction such system may not always present conditions promising immunity from fire through the faults of design and installation.

Experience has fully demonstrated that the important feature of fire hazard has not generally influenced the design and introduction of such systems, this being particularly true in relation to the conditions found to exist in the average school house and church structure, as well as in many public halls, court houses and the like, where it is not at all unusual to find wood ducts or conduits in use, not only for conveying the outer air to the base of the heating furnace, but also as flues for conveying the heated air to points of distribution, and for the removal of the cold and foul air from the heated enclosures; this practice in either of its phases is most reprehensible, and under intelligent supervision and regulation is never sanctioned, while in advanced communities such practice is in violation of the law and subjects the responsible violator to prosecution and penalty on conviction.

Under this method of heating and ventilation are to be found two distinct systems respectively known as the *"direct"* and the *"indirect."* Under the former the foul and dust laden air is carried from the floor of the rooms through ducts or flues by action of the heated air currents which displace the foul, and these flues deliver the foul air above the roof of the building, thus securing the direct ventilation which serves to indicate the method, and where such system is properly installed it presents the least hazard of these combination systems.

The "Indirect" system, such for instance as the "Smead System," seeks to secure the removal of all foul or cold air, not only from the area of the room enclosures, but also from all of the hollow spaces surrounding the same, including the spaces between the floor joists and the partition studding; to accomplish this end, the area of space between the floor joists is increased by nailing 2 x 4 wall strips across the joists, and openings are made through partition walls from the joist-channels to the spaces between the studs, thus providing a complete maze of communicating horizontal and vertical spaces, accessible to flame while inaccessible to means of extinction, the whole presenting a most cunningly devised means of insuring rapid combustion and destruction of the building in case of fire.

In some instances the above objectionable features of the "indirect" system are found to be materially aggravated by the presence and use of the so-called "dry-closet" system (Smead System), in the operation of which excreta from the toilets is destroyed by burning with the aid of volatile or highly combustible material such as gasoline or kerosene oil for fuel, hence, where the "indirect" system is in use, with or without the "dry-closet" attachment, we prefer to decline the risk absolutely.

As it is entirely within the bounds of commercial practice to install these combination systems in a manner which will markedly minimize, if it may not entirely eliminate, the danger of fire now so evident in general practice, there is no good reason why such precautions should not be insisted upon in all cases, whether the installation be new or old, and we therefore submit the following suggestions as being based on good practice in relation to construction and installation of such systems.

HEATING FURNACES should in all cases be erected upon a solid foundation of brick or stone, with hearth of brick, stone or cement not less than 36 inches wide in front of the ash pit. The top or dome of the furnace, and also its smoke pipe, should not be less than 18 to 20 inches from unprotected woodwork or lath and plaster, and its side walls should be at least 12 inches from combustible material.

SMOKE STACK OR CHIMNEY should be built of sound, hard brick on a solid foundation, with double walls well bedded in cement mortar and having an air space between the walls, with all joints inside of flue carefully pointed; or may be single walled, not less than 8 inches thick, enclosing burned clay smoke flues, or if without such smoke flues, walls must not be less than 8 inches thick and all joints, both inside and outside, should be as carefully "pointed up" as would be called for in a pressed brick front. Stack should be carried 4 feet above the roof, and all timbers or woodwork exposed to stack should be framed around same, leaving an air space of not less than 2 inches on all exposing sides.

HOT AIR DUCTS should preferably be entirely of brick or hard burned terra cotta tile, properly insulated from contact with woodwork or other combustible material, but may be constructed of expanded metal and plaster or of bright charcoal tin; properly supported and insulated by air space of not less than 2½ inches from all exposed woodwork in either case, and if constructed of tin, to be made double with an air space of not less than ½ inch between the inner and outer flues when passing through or within wooden or lath and plaster partitions.

FOUL AIR DUCTS should be constructed in same manner as suggested for hot air ducts, but may be installed with not less than 1 inch clear space to woodwork. Ducts should not be connected directly with heating furnace nor any hot air or smoke flue, but preferably to a special flue adjoining a brick smoke or hot air flue carried to the same height, but separated therefrom by not less than 4 inches of brick work. (The radiated heat from the smoke flue will thus induce an upward current in the foul air duct adjoining.)

If foul air ducts be not connected to smoke or hot air flue as above suggested, they should each empty into a vertical flue of proper construction, which should extend above the roof of the building, in which case the bottom of the flue could be left open and an upward current be induced by the heat from the furnace room, or by location of an open gas flame at base of flue.

HOT AIR REGISTERS, when placed in wooden floors or wainscoting should be set in soap-stone frames not less than 2 inches wide, well set and embedded in plaster of Paris. Register boxes where passing through floors or wainscoting should be made of bright charcoal tin, having joist or floor timbers framed around them to leave a space of from 2 to 2½ inches on all sides according to the size of the box, the exposed woodwork to be covered with bright tin on all sides, extending from under the soap-stone frame to and under the ceiling or open joist below.

At least one register of any system should always be kept wide open, either by the removal of the vanes or by securely wiring the valve to prevent its being closed.

COLD AIR DUCTS should preferably be entirely of brick, metal or other non-combustible material, but may, under approved conditions, be of wood up to a point not closer than 5 feet from inlet base at furnace, from which distance the construction should be entirely of brick, metal or other non-combustible material. The duct should extend to the outer side of the building wall and be provided with wire net or grating at that point.

As the average installation of heating and ventilating apparatus is seldom found to closely conform to the above suggestions for safety, there may be cases where the deviation from the lines laid down are of such minor character as to not seriously increase the fire hazard beyond that of the nature of their surroundings and in such instances the judgment of the inspector should be exercised as to the proper course of action, always taking the benefit of a doubt on the side of caution where proper remedy cannot be promptly secured.

In the average district or village school house the most frequent deviations from safe practice will usually be found to lie in the character of the material used in the construction and the arrangement of the foul air ducts or flues or the trunk flue conveying air to the fire box of the furnace or heater, and in illustration of such conditions we cite the following instances of dangerous practice as developed by recent inspections.

(1) **FOUL AIR FLUE** (vertical) discharging under the roof in attic, thus providing means by which fire would very quickly reach the most inaccessible portion of the structure and gain headway before discovery. Such arrangement should serve to condemn the risk, whether the flue be non-combustible or of wood, as in either case the accumulation of dust and fluffy flyings would serve to feed a flame.

(2) **FOUL AIR DUCT,** leading from outlets at floors above the heating device to the base of same at fire box. The method here noted is essentially dangerous, as falling embers from the furnace grate are liable to ignite the dust, paper or other refuse which accumulates in the duct, and thus convey fire to the building. Where such conditions exist they serve to condemn the risk, whether the foul air flue be of wood or of non-combustible material.

(3) **FOUL AIR FLUE** (horizontal) passing under the ceiling from the floor outlets above the furnace room and opening into the smoke flue of the heater stack or chimney; arrangements of this character may well be classed as excep-

tionally hazardous, as the heated air of the smoke flue serves to carbonize the accumulation of dust, flyings and other refuse adhering to inside of foul air duct, and will eventually ignite same, while a rising spark from a newly kindled fire in the furnace is almost sure to cause such ignition and carry flame to the interior of the structure, hence, the presence of such conditions will render the risk unacceptable.

(4) **FOUL AIR FLUE** (horizontal) passing under the ceiling of heater room or cellar and emptying into open room. This practice presents an unnecessary open ended flue by which fire would rapidly pass into the structure and be difficult to extinguish, and while this condition is not as hazardous as the instances above cited, it is sufficiently objectionable to warrant severe criticism and demand for the use of non-combustible material in construction of the flue with a wire screen at its outlet. The method is unsanitary.

(5) **HOT AIR FLUES,** when constructed of wood, serve to condemn the risk entirely.

(6) **COLD AIR DUCT,** when entirely of wood up to entrance of furnace shell, presents a feature of hazard but slightly less objectionable than the deviation noted under citation No. 2 and for the same reasons and demand should be made for substitution of non-combustible material for a distance of five feet from the furnace shell.

From the above citations it is apparent that much care must be exercised by the inspector in the examination and study of the deviations from good practice which will come before him, and while strict adherence to the above precepts may result in the loss of some otherwise desirable risks, it is wiser to lose the premium on same than to pay the face of the policy on any from loss arising from defects noted, or from others of like hazard which inspection may develop.

In conclusion, every effort and argument should be used by the inspector to bring all heating and ventilating installations up to the standard of safety above outlined wherever possible and to secure improvements or changes in arrangement where such action may result in making the outfit reasonably safe, bearing in mind that intelligent explanation of the defects and of remedies for same, together with firm insistance for compliance to safe practice will in many instances bring about the desired reforms, and that where it becomes impossible to secure the elimination of unsafe conditions, it is best to keep off the risk.

F. M. Griswold

General Inspector

New York, February, 1907.

Window Glass Works

THE HOME INSURANCE COMPANY
NEW YORK

Window or Sheet Glass Works

Preliminary to the consideration of the physical hazards incident to the production of window or sheet glass, it is deemed proper to present the following remarks in relation to the changes in operating methods which have been introduced in this industry since my brief report on the class, which was in the form of a supplement to the monograph on PLATE GLASS, issued by the HOME, October, 1902.

During the past ten or fifteen years there has been taking place marked changes in the methods of producing window glass; in the earlier methods practically all window glass was made by hand labor, which gained high wages through its skill in forming cylinders from the molten metal by off-hand blowing and manipulation, but under labor union restrictions production was usually limited to not more than nine or ten months' operation during any one year or "fire," thus presenting such onerous and unfavorable conditions in the industry that the manufacturers began experimenting with mechanical blowing devices, by the use of which they might hope to secure better control over the operation of their factories and in the handling of the business.

The result of these efforts has been the gradual improvement of machine blowing and drawing devices designed to almost completely replace skilled hand labor, with such success as to now show some nine or ten different types of such machines, each of which while different in methods of operation, is claimed to be capable of producing the highest grade of cylinder glass at a most marked reduction in labor cost as compared with off-hand operations.

In addition to these cylinder drawing and blowing devices, there is now under experimental operation a device for drawing the molten metal directly from the melting tank in the form of sheet glass, thus entirely eliminating the blowing process incident to the formation of cylinder glass by hand or machine methods.

Supplementing the successful operation of the mechanical blowing and drawing devices, radical changes have taken place in the method of melting glass through the substitution of tank furnaces in lieu of the pot furnaces formerly in general use for that purpose, with the result that the use of pot furnaces in this industry has become practically obsolete, as the

introduction of the tank furnace not only served to materially reduce the expense of up-keep, but also more than doubled capacity for production. It is therefore doubtful whether any window glass factory operating with a pot furnace equipment could maintain a profitable existence in competition with a modern plant having tank equipment.

The process methods of window glass production include some hazards of considerable intensity due to the use of many heat producing devices, in some of which the temperature reaches from 2,600 to 2,700 degrees Fahr., in addition to those of more common nature incident to packing and storage of the finished material, as may be noted in the following description of the processes involved:

Raw Stock.—The material used in forming the "batch" for melting generally includes washed and dried silicious sand, lime or crushed lime stone, soda ash (salt cake), and a portion of arsenic (cobalt) or other metallic base for coloring; waste or broken glass (cullet) also being utilized. These materials usually come to the plant properly prepared for mixing into the batch, and aside from the possibility of spontaneous ignition of the lime, are without inherent hazard.

Melting Furnaces.—Under modern practice these devices are of the tank type, built of brick, lined with refractory material and supported on heavy brick arches; natural or producer gas which has passed through a regenerating furnace to intensify its heat is used for fuel. These tanks may be of the continuous type, into which the batch is fed at one end and when melted is "gathered" at the other by off-hand blowers, or is delivered direct to the supplemental tank of the mechanical drawing and blowing device, the process of charging and gathering being continuous day and night during the fire or until accident compels a shut-down.

Another class of tank furnace is of similar construction but of smaller size, known as a "day tank," in which the batch is charged during the night and melting is continued through day working hours only; this type of tank is usual in hand operated plants only.

Prior to the introduction of tank furnaces the batch was melted in pot furnaces of circular form, with inside lining, bench and crown of refractory clay blocks, the outside walls being of brick tapering above the crown to form a stack or chimney, the whole being supported on heavy brick arched foundation with an arched "cave" and tunnel underneath the bench; this type of furnace ranged from ten to twenty-four pots capacity, and was heated by natural or producer gas, by coal fire, or all of these in combination, either by direct flame from the fuels named or through the use of regenerative furnaces.

In this type of furnace the melting pots undergo preliminary heating to prepare them for charging with the batch, and when the mass has become fluid the glass is gathered by hand and blown into cylinders of various dimensions by skilled off-hand blowers.

The working floors and their supporting members and the floors surrounding the base of either of these types of furnaces should be of fire-proof construction for a distance of at least twenty feet in all directions, and in addition, a brick bridge or dam should be built across the tunnel where it pierces the supporting walls of the furnaces, these precautions being necessary to prevent ignition of combustibles through contact with escaping molten glass from ruptured tank or pot; it may be here stated that very few, if any, pot furnaces are now in use in the window glass industry.

Reheating Furnaces.—These devices are usually circular in form with dome shaped tops, built of brick and heated by gas or fuel oil flame and closely adjoin the blow or swing pits in which the off-hand blower swings the glass cylinder while forming it. The surroundings of these reheaters should at least be of fire resistive construction, including the supports of the blower's platforms. This type of furnace is used only in hand operated shops, no reheating being necessary where the cylinders are machine drawn and blown.

Machine Blowing.—Mechanical drawing and blowing devices are in successful operation for the production of high grade window glass and differ only in respect to the method by which the molten metal is fed to the several types; in one type it flows from the melting tank through a gas heated spout or "dog house" to a small stationary tank directly underneath the drawing device; another draws the metal from a small stationary gas heated tank which is filled with metal by hand operated ladles, while a third type is supplied in sequence from three horizontally rotating feed tanks, which are filled from the melting tank by hand manipulated ladles. Each of these classes of supplemental tanks and the "dog house" is constructed of refractory material and heated by gas flame to a temperature which insures proper fluidity of the metal while it is being drawn; hence, it is essential that the immediate surroundings of these drawing devices and their heat producing adjuncts should be of fire-proof construction.

These mechanical blowers draw cylinders of from 20 to 35 feet in vertical length and from 20 to 42 inches or more in diameter; the circumference of the drawn cylinder fixing the length of the sheet, while its width is determined by the length into which the cylinder is divided sectionally, this being in contradistinction to the practice as applied to hand drawn cylinders, the length of which controls the longest dimension of the sheet, while its circumferential measurement limits its width.

In operation the mechanical blower drops its drawing head or "thief" or "bait" into contact with the molten metal which adheres to it and is drawn vertically by lifting the draw-head, which is guided in its course by fixed side rods, and at the same time air under pressure is forced into the rising cylinder until its elongation is completed, the operation of drawing and regulation of air pressure being secured through electrical devices under control of skilled operators perched in pulpits; when drawn the cylinder is cracked off at its top and base and removed from the drawing device by a vertically swinging hinged crane-arm and brought to a horizontal position preparatory to being cracked into sections and in a longitudinal line, prior to its entry into the flattening oven.

It will thus be seen that in the operation of these mechanical drawing and blowing devices all highly skilled labor by hand is dispensed with, the simplicity and economy of the operation being in marked contrast to that of hand operated plants, in which high priced skilled hand labor is necessary for both gathering and blowing, and at the same time the volume of output and the quality of machine blown glass is claimed to be superior in every respect.

Flattening Oven and Lehr.—In this device the oven forms the head of the lehr; it is constructed of brick with flat or arched top and is lined with refractory material, including a carefully leveled fire-clay bed, and is heated by means of gas flame, coal fire or fuel oil; the "roller" or cracked cylinder is placed in the oven with the cracked side uppermost, where, under the influence of heat the glass is softened and the cracked cylinder opens until it lies flat on the bed of the oven; it is then further flattened and smoothed by passing over its surface prepared hard-wood blocks, this being a hand operation necessitating skilled manipulation; when flattened the sheet is pushed forward onto a metal conveyor within the lehr, which latter device is of brick construction, with flat or low arched top, heated at intervals of its length by gas flames of reducing temperature to the "take-off" or delivery end of the device, at which point the cooled sheet is removed by hand to the cutting and packing rooms

This device should be of substantial construction, be kept free from contact with combustible material, including such as is too frequently to be found piled on top of it.

Cutting and Packing.—These processes are usually carried on in structures of considerable area, in which the sheet glass is cut to dimensions on gauged tables, and then packed with hay, straw or excelsior in light wooden boxes or crates; both cutting and packing are done by hand, the packing operation necessitating the presence and use of large quantities of combustible material, in the handling of which much readily ignitable rubbish is produced, hence, packing material

should be restricted in quantity to that necessary for the day's use, be kept in bins with self-closing covers, and all rubbish should be removed from the packing room at the close of each day's work.

Box or Crate Shop.—The material used in the construction of these containers usually comes to the shop in shooks cut to dimensions, and is nailed together by hand or machine; shooks are sometimes stamped or printed in a power press, necessitating the presence and use of some volatile detergent for cleaning purposes; such volatiles should be kept in approved safety cans of capacity not in excess of a day's supply, the bulk of such material to be properly housed outside of shop.

Lumber and shooks when not in process of conversion into packages should preferably be piled under cover and be so located as to not form an exposure to the plant.

Warehouses.—These structures are usually of extreme area, frequently being located in groups forming mutual exposures of note; the principal hazards being those of large area and the readily combustible nature of the packages which they contain.

It may be noted here that when sheet glass is subjected to the effects of heat due to a fire and in contact with water, it is liable to take on surface stains from the wetted packing and the corrosive action of smoke; these stains are said to become indelible unless the glass be removed from its package, washed and properly dried within two weeks after the damage occurs.

F. M. Griswold

General Inspector

New York, July, 1915.

Plate,
Rolled and Cathedral
Glass Works

THE HOME INSURANCE COMPANY
NEW YORK

Plate, Rolled and Cathedral Glass

The methods of producing glass of the classes above indicated are identical in respect to general processes, the principal differences being in the nature of the raw material composing the batch, which, when melted, is formed into plates on an iron casting table by passing an iron roller over the mass, the operation of producing the rough plate necessitating the use of very simple mechanical devices and appliances, without the complications usual to other classes of glass production.

Raw Stock.—In preparing the batch for plate glass production the principal ingredients used include washed and dried sand, high in silica content, soda ash (salt cake), lime or crushed limestone, with a portion of arsenic or other metallic base for coloring, the waste or broken glass (cullet) also being used.

The materials composing the batch for producing so-called rolled and/or cathedral glass, contain in addition to that used in plate batch, any or all of the following materials: cryolite, feldspar, fluorspar, lead and zinc oxides or other metallic bases. It is to be noted that none of these materials is of combustible nature, nor do they present any fire hazard as incident to their use, but the chemical reaction which is brought about by the liberation of fluosilicic acid during the process of fusing cryolite is liable to disintegrate and break down the material composing the melting pots and/or tanks, thus permitting the possible escape of the molten glass, which coming into contact with combustible material might serve to ignite it.

Melting Furnaces.—May be either of the tank or pot type, usually constructed with heavy brick walls lined with refractory fire brick or clay blocks with arched tops and iron back stays; tank furnaces are usually built over brick arched foundations, with a cave opening into brick arched tunnels under the bench of the furnace; in such cases the tunnels should be bridged or dammed to a height of two feet at the point where they pierce the supporting walls of the tank, in order to prevent the outflow of molten glass should the tank break down.

Pot furnaces are generally rectangular in shape, built in a manner similar to the tank furnace, but resting on a solid foundation of fireproof construction; these furnaces may have capacity for twenty or more pots each; each pot is separately filled with batch and the melting is produced by ignition of gaseous fuel which circulates around the pots within the furnace. Owing to the intense heat (2700° F.) generated in the pot furnace, it becomes necessary to rebuild them about every three months, hence one or more furnaces may be under repair at any time.

The floor surrounding a pot furnace should be of fireproof construction for a distance of at least twenty feet in all directions, in order to prevent ignition of combustibles in case a pot of metal should be ruptured while being handled.

In tank furnaces the batch is fed in at one end, and as the molten glass is removed for casting, fresh portions of the batch are added. These tanks may be of the continuous type in which the melting of batch continues day and night through the whole season or fire, or until the tank needs rebuilding, and the day tank, in which the melting is carried on during the night, the metal being withdrawn for casting during the day working hours only.

The working floor for at least twenty feet on all sides of a tank furnace should be of fireproof construction with fireproof supports. The floor at and around the base of the tank foundation should also be of fireproof character to the same extent to prevent possible ignition of combustibles in case of molten metal escaping from a ruptured tank. The omission of fireproofing around both pot and tank furnaces as suggested creates a hazard not to be overlooked.

Process Methods.—Where pot furnaces are used for melting, the pots are set in the furnace while empty and given a preliminary heating by coal fires or gas flame to temper them for receiving the batch without danger of rupture, each pot then being charged while in place and subjected to gradually increased temperature until the batch becomes fluid.

In this class of furnace the breaking down or rupture of a pot inside of the furnace would not produce any particular fire hazard as the molten metal would be held within the furnace walls.

Where tank furnaces are used the tank undergoes a like preliminary heating to prepare it for the reception of the batch, which is rendered fluid by the use of gas flame intensified by passing through a regenerative furnace. The rupture or breaking down of a tank would permit the escape of large quantities of molten metal which would readily ignite combustibles with which it might come into contact, hence, the necessity for fireproofing the surroundings of the tank and the provision of a bridge or dam in tunnels near the cave becomes evident as an essential precaution.

Casting Plates.—The pots containing the molten metal are removed from the melting furnace by balanced tongs supported on a trolley track, and may be transferred manually or by power to the "casting hall" which communicates with the furnace room; the fluid glass is poured upon an iron table, the sides of which are raised to the thickness gauge of the sheet to be produced, and the mass is flattened by passing over it a heavy iron roller supported on the raised edge of the table.

Where tank furnaces are used the molten glass is dipped out of the mass by ladles and transferred to the casting tables on trolley track. When cast and rolled the rough plate passes from the table either to a lehr or kiln for annealing.

Annealing or Tempering.—Under older practice the rough plates pass from the casting table to a gas heated annealing kiln built of brick and lined with refractory material, each kiln having capacity for three plates; the plates enter the kilns at a bright cherry red heat, the kilns then being closed, the heat being continued at reducing temperature for periods ranging from 72 to 96 hours, when the plate may be handled for removal to the "grinding hall."

Some plants of this older class may still be in service where operators adhere to the mistaken idea that kiln tempering is the only means by which the homogeneity in temper of the plate can be secured to prevent rupture under changes of temperature when finished and set, but the fallacy of this contention is proven by the fact that all modern and successful plants of the class are now equipped with lehrs for annealing; these devices are built of brick with flat or arched tops and are heated by gas flames located at stated intervals within their length of several hundred feet; the cherry red plate passes from the casting table to a hot chamber at the head of the lehr, and when at the right temperature passes to a travelling metal apron which is mechanically progressed through the length of the lehr while exposed to gradually decreasing temperature until it reaches the delivery or "take-off" end cool enough to be handled.

The use of lehrs for tempering serves to materially reduce the fire hazard due to the numerous fire heated kilns incident to the older practice of annealing.

Grinding Rough Plate.—The plates leaving the lehr or tempering kiln are embedded in plaster of Paris on the surface of large horizontal rotating tables, over which a series of grinding devices are rotated in contrary direction, the abradant being sharp sand of three or four grades of fineness, followed by three graded sizes of emery; in each grinding process an abundance of water is used on the surface of the plate to facilitate grinding and carry off the worn abradant as each grade is replaced by that of lesser sized grain.

While this abundant use of water serves to keep immediate surroundings constantly wet at vicinity of the grinding tables, the necessarily immense areas of these "grinding halls" presents a difficult problem in the control of fire once gaining headway in the roof or other combustible portions of the structure, hence it becomes exigent to provide for the use of fire resistive material in construction and roofing of these buildings, such as appears to be the general practice in modern plants, where the large areas call for substantial brick or concrete enclosing walls for support of structural steel roofing and upper works.

Polishing Ground Plate.—This process is quite similar to that of grinding, an abundance of flowing water being used at the tables; the abradant or polishing substance is rouge (peroxide of iron) which is applied to the surface of the plate; the polish is secured through the rotary action of cloth or felt covered pads, which rub the abradant over the face of the plate. French, English and American polishing devices are found in use, either in combination or singly. Some hand polishing is done for higher finish when plates have been cut to dimensions for the trade. "Polishing halls" are also necessarily of very large area, and in matter of construction should conform to the suggestions made in relation to grinding halls.

While the materials used in grinding and polishing processes are non-combustible in their raw state, some comparatively mild hazards are created through the presence of heat producing devices necessary for preparing the material for use, in that rouge is burned in a brick arched furnace using coal fire or gas flame for heat; sand is dried in a rotating iron cylinder with direct fire heat and the hard plaster, after removal from the grinding and polishing tables, is dried at a moderate heat in brick furnaces, while the grinding of gypsum and hard plaster may present some slight hazard due to possible heat from friction at the bearings of the mills.

Danger from the presence and use of any of these devices can best be avoided by freeing them from contact with or dangerous proximity to combustible material of all kinds.

The process hazards incident to the production of rolled and cathedral glass are identical with those of plate glass except in the matter of finishing the cast material. **Rolled Glass** is usually cast rough, and after leaving the lehr or tempering oven, is sorted, cut to dimensions and packed for shipping; such ornamentation in design as may be desired being secured during the process of casting and rolling.

Cathedral Glass is usually cast in rough finish, the plates being both less in thickness and surface area than either rolled or plate glass. Opalescent glass is produced from a batch containing cryolite and is generally cast into sheets of various thickness on tables of medium size. This material is used

for making tile, linings for ice chests, table tops and in combination with cathedral glass for decorative purposes. Grinding and polishing of these various sized units is usually accomplished on tables of comparatively small size.

Wire Glass is produced by processes similar to those incident to rolled glass, the introduction of the wire reinforcement within the body of the molten glass being accomplished by two different methods; in solid wire glass the wire mesh is firmly stretched over the casting table bed in position to leave an under-space equal to one-half the thickness of the plate, and the molten glass is poured over it and rolled, thus forming a solid plate; in making so-called "sandwich" wire glass the metal is poured onto the casting table to a depth equal to one-half the thickness of the plate, and while still in fluid state the wire mesh is stretched over it, and additional metal poured to the desired thickness and the mass is then rolled and passed to the lehr or annealing oven. Various ornamental or other designs are impressed upon the surface of the plate from patterns cut into the bed of the casting table or on the surface of its roller. Grinding and polishing of wire glass plate is performed by the same method as in the case of plate glass.

It may be well to note here that all grades of polished glass, when packed, are subject to take on almost indelible surface stains by the deposition of coloring matter from wet packing material, and the corrosive action of smoke in case of fire. These stains are said to become absolutely indelible unless the plate is removed from its package, carefully washed and properly handled within two weeks after the damage occurs.

Pot Making.—Practically all plants of this class make their own melting pots where such are used, and where tank furnaces are operated the blocks and other shapes forming the melting tank structure may be produced, usually in separate structures on the premises. The raw stock used in the production of both pots and blocks or other tank shapes consists of a mixture of special grades of clay, which after being washed are mixed in a pug mill and the mass is then packed into bins, where it may remain for six or more months for tempering.

When properly tempered the clay is mixed with other refractory material including portions of finely ground old pot shells and tank blocks, the whole being again intimately mixed and formed into the required shapes.

Pots are slowly built up by skilled hand operators, requiring considerable time for completion, and are then left to season for from six to eight months subject during that period to the drying effect of normal temperature in summer and to mild artificial heat produced by open gas flame or low pressure steam during cold weather. Where gas is used in

the drying process, the flame is usually an open one of the "jumbo" or flambeau type, necessitating the protection of exposed wood-work and other combustible material against ignition by these large flames.

The green pots when fully seasoned are burned in a "pot oven" constructed of brick with arched tops, heated by gas flame or coal fuel; these ovens are usually located inside of or contiguous to the casting hall, though sometimes to be found near the pot shop; as a general rule these ovens are of inferior construction and should be so located as to prevent exposure to or contact with combustible material.

The fire hazard of a pot shop is very mild, the principal danger being in the use of open gas flames for drying purposes, and in non-enforcement of restrictions in regard to smoking by the employees. As the average life of a pot while in service seldom exceeds six weeks, a large reserve stock of green ware is usually found in the pot shop dry rooms, and at this stage of making they are more susceptible to damage by water than by fire.

Box and Crate Making.—The box or carpenter shop usual to this class of works is frequently of large area, generally communicating with the packing and shipping rooms without proper cut-offs between. The use of steam or electric power machinery is common, and large quantities of box or crating lumber are usually kept inside of the structure; as these conditions present the hazards usual to power woodworking establishments, careful attention should be given to the daily removal of combustible waste material which accumulates about the machines and benches.

Packing and Shipping.—Packing and shipping rooms are usually of large area, and as a matter of convenience in handling the finished plate are connected to the polishing hall, generally without protection at points of communication. Large quantities of straw, hay and other combustible materials are kept in stock and used in packing rooms, entailing large accumulations of combustible rubbish in such localities. All such packing material should be kept in covered bins restricted in capacity to the amount required for the day's use, and accumulations of refuse should be removed from the premises each night.

As the box shop, packing and shipping rooms form the most serious fire hazard in plate glass works, it is urgently suggested that such departments be equipped with automatic sprinklers for prompt protection in case of fire, to prevent its spread to other portions of the plant not separated from them by fire walls and fire doors.

In summary it may be said that as a whole, the hazards of this class of glass production are decidedly mild as compared with the process method incident to the production of

glassware in general, as shown in my monograph on "Glass Works other than Plate and Window Glass."

The use of lehrs in tempering plate glass as practiced in the more modern plants serves to reduce the general fire hazard of the class by the elimination of many heat producing devices necessary in tempering where ovens are used for that purpose, and it may also be safe to assume that these more modern installations promise larger commercial success in operation than is possible under the more antiquated methods, as the equipment of these plants necessitates large financial investment and the exercise of superior management to insure profitable operation under the keen competition evidenced in this important industry.

F. M. Griswold

General Inspector

New York, July, 1915.

Glass Works
other than
Plate or Window Glass

THE HOME INSURANCE COMPANY
NEW YORK

Glass Works in General
Other Than
Plate or Window Glass

In considering the hazards incident to the production of blown, pressed and moulded glass ware, it is attempted to group the various processes into two classes, as indicative of the comparative fire hazards of each.

Blown Ware.—Including all kinds of bottles, milk, condiment and preserve jars, lamp chimneys, globes and electric light bulbs, special designs and irregular work containers.

Pressed and Moulded Ware.—Including tumblers, bowls, table-ware, wines, bar goods, stem ware, blanks for cut glass, founts for oil lamps, specialty and novelty ware.

In the production of blown ware the use of automatic or semi-automatic blowing machines has become very general, though in some instances both off-hand and machine blowing are to be found in same plant.

In moulded, pressed and cut glass plants hand power operations prevail, such machines or devices as may be used not being designed for either automatic or semi-automatic operation.

It may be well to note that in some instances it may be found that several of the classes above indicated are included in the output of a single plant, and it may be further assumed that, where the product of any glass plant includes a variety of articles, that the fire hazard is proportionately increased over those in which a single or selected class of work is produced, on account of the introduction of processes not incident to glass working *per se*, such as decorating, lacquering, buffing of metal work, and the presence and use of a much larger quantity and variety of packing material in the mixed product house.

The Raw Stock used varies with the class of goods produced and ranges from a simple batch mixture of sand, air-slaked lime, crushed limestone, soda ash or nitre or potash, with manganese or antimony for coloring in the bottle works to a combination of the above with cryolite, feldspar, fluorspar, lead or zinc oxides, sulphur, carbon (ground cannel or bituminous coal), and arsenic, in works covering a wider range of product.

It is to be noted that none of these raw materials, except carbon, lime, nitre and sulphur, present inherent fire hazard, while lime and carbon may be assumed to promote the possibility of spontaneous ignition under certain conditions; nitre and sulphur are without particular hazard when not in combination with other material not usual to this class of manufacture, but each of these materials, when fused under the action of heat, would add to the intensity of combustion; sulphur when ignited will produce sufficient heat to set fire to woodwork or other combustibles, but the fumes arising from its combustion, if confined, would tend to retard the spread of flame; the ignition of nitre would serve to aggravate combustion of other material by the liberation of its oxygen, and, when in contact with sulphur and carbon, might produce a combination promoting an explosion of some violence; but as each of these materials is usually stored separately until mixed in the "batch," the probability of an explosion appears to be remote under ordinary practice, and may therefore be neglected in the summing up.

Cryolite, a double fluoride of sodium and aluminum, is said to be the most costly of the raw material used in the production of glass in the processes under consideration. Its principal use is in the production of "opal" or "opalescent" glass, and owing to the development of fluosilicic acid during the process of fusion, it is liable to break down or disintegrate the melting tank or pots, and thus permit the escape of the molten metal, and perhaps cause a fire. It is to be presumed that manufacturers understand this condition and provide against accident from it. The inquiry should be made.

Raw Stock Process Hazards.—The preparation of raw stock, as grinding, screening and mixing, presents only mild hazards, and where the grinding and other mechanical devices are kept free from contact with woodwork or other combustible material, there appears to be little danger of fire from friction or sparks possible of production in operation.

Melting Furnaces are of several class, *i. e.*, "continuous tank," in which the "batch" is fed into one end and when melted is "gathered" at the other by off-hand blowers or by automatic machines, the process being continuous night and day, during the "fire," or until accident compels shut down. "Day tanks," in which charging with batch is done at night, and the melting continued until the day-shift comes on, the "gathering" being carried on during the day hours only.

These tank furnaces are usually rectangular in shape, with interior construction of fireclay blocks and brick with an arched crown and a "down draught" flue; they are heated by natural or producer gas flame, intensified by passage through a regenerative furnace, and are generally supported on brick arches and piers, and as the temperature used in melting the batch reaches some 2,600 degrees Fahrenheit, the structure should be well removed from contact with woodwork and combustibles. Batch is fed to these furnaces by hand as a rule, but where a chute is used, the material of same should be non-combustible.

Where melting is done in pots the furnaces are usually circular in form, with an inside lining, bench and crown of fire-clay blocks and brick, and an outside brick enclosure tapering above the crown to form a stack or chimney, as in a pottery kiln. The foundations of this class of furnace are usually of brick, from 8 to 12 feet in thickness, with brick arched "cave" or tunnel underneath, but, as a rule, these walls are to be found in contact with floor beams and other woodwork, and while it is true that some of these furnaces have been in use for thirty or more years without firing the woodwork, the conditions do not appear to warrant continued immunity in this respect.

Generation of heat in this class of furnace is secured by the combustion of natural or producer gas, or a combination of the two, either by direct flame or through regenerative furnaces. It is claimed by some glass manufacturers that the use of regenerators in a pot furnace has a tendency to break down the pots from the intensity of the flame, and thus permit the escape of the molten glass into the tunnel or "cave" and create a fire. Some of these furnaces are constructed to burn bituminous coal, either alone or in conjunction with natural gas, when the latter commodity is low, but in either case the fire hazard is practically identical.

Some pot furnaces are rectangular in shape, of the same general construction as above, but are usually provided with down-draft flues, for the escape of the products of combustion.

The working floors surrounding tank or pot furnaces should be of brick or concrete on fire-proofed supports for a distance of at least twenty feet in all directions, and the floor at and around the base of the furnace should be of earth or fire-proofed.

The "cave" or open space immediately under the bench of both tank and pot furnaces should be provided with a brick bridge or dam, not less than two feet in height at the tunnel or passageway through the supporting walls of the furnace, in order to prevent the spread of molten metal should pot or tank break down when heat is on.

Glory Holes are usually constructed in form similar to the circular pot furnace, but of smaller diameter, and are fired by an open gas flame located about "waist high" above the foundation, which thus does not convey much heat downward. These devices are frequently found built up from the floor as a foundation, but it is preferable to have the supporting walls rise from the ground, and be free from contact with combustible material.

The use of fuel oil in these devices is an occasional practice, and when the method of feeding the oil to the furnace complies with accepted rules, there is practically no increase of hazard over that incident to the use of gaseous fuel.

Annealing or Tempering Furnaces are of two classes, either "ovens" or "lehrs," the former usually of small or medium size, arranged in a series of three or four adjoining, constructed of brick with fire-clay or fire-brick lining, heated by open gas flames about "waist high" above foundation, in arrangement something like a baker's oven, into which the hot glassware is introduced by hand and removed from one oven to the other, each being heated at a reduction in temperature to perfect annealing without rupture. Like the glory holes, these devices are found with foundations resting on the floor, and, in addition, are frequently carelessly arranged in relation to contact with woodwork and fender boards.

The lehr is constructed with brick walls and a flat arched brick top, and, is heated by open gas flames for about two-thirds of length, the highest temperature being a cherry-red heat at the receiving end, reducing to practically "nil" in temperature at the delivery end. The hot ware from the blowing stand or automatic machine is placed by hand on iron trays at the receiving end, and the filled trays are slowly progressed through the length of the lehr on an endless chain-conveyor to the delivery end, whence the ware is removed practically cool. In the older style of lehr the operation of manipulation is manual, the receiver at the delivery end advancing the conveyor by hand-lever a sufficient distance for the removal of a tray of cooled ware, while a new tray is being placed in the receiving end. In the more modern device the operation is automatic, the hot ware being delivered to the receiving end by a mechanical trolley-carrier connected with the blowing-stand of an automatic machine and the loaded trays are slowly progressed by mechanical means to the delivery.

This automatic lehr is not only in the line of economy of operation, but also serves to lessen the fire hazard, as by its use the services of the "carrier-in" boys are dispensed with. It is evident that both classes of annealing devices should be substantially constructed with foundations on the ground, and be kept free from contact with combustibles, including such material as is frequently found piled on top of the arches of both lehrs and owens.

Pot Arches are constructed of brick with fire-clay or fire-brick lining with flat arched tops, and heated by open gas flame; they are used for the preliminary heating of the pots before placing them in the melting furnace, where they are then charged with the "batch"; in order to transfer the heated pots from the arch to the furnace with the least probability of rupture from cooling, the arch must be located adjacent to the furnaces, hence they are frequently constructed as an addition to the melting house, and not infrequently are carelessly arranged as to exposed woodwork, thus creating an aggravated fire hazard which could be avoided by more careful construction and arrangement.

Pot Making carries with it but little fire hazard unless old pot shells are ground up in the premises, and in that case the principal hazard would arise from the friction of machinery when in contact with combustible material. Pots are made from special qualities of ball and plastic fireclays, both of foreign and domestic character, and are slowly formed from moistened clay by hand manipulation, are dried without the aid of artificial heat in summer, and at a temperature of not over 75 degrees Fahrenheit in winter. Most if not all pot house fires have been traced to carelessness in smoking by the hands employed. As a rule, the pots for use in the classes under present consideration come to the works finished and ready for heating in the pot arch.

Burning or Decorating Kilns for ware are similar to those used in potteries for the same purpose, except that "saggers" are not used; they are usually constructed of brick, with flat or arched tops of iron or brick, and are provided with a series of metal shelves upon which the ware is placed for burning in the colors. Natural or producer gas flame is used for heat, but the temperature is maintained at a degree which will fuse only the metallic oxides in the decoration and not affect the surface of the glass. These kilns are usually grouped in series of three or more, and should be securely separated from the decorating department, and be constructed without contact with wood or other combustibles. There are also in use burning kilns constructed like lehrs, and these should be treated as previously suggested under the heading "Annealing."

Producer Gas installations are now in general use as constant sources of gaseous fuel supply, or in supplement to natural gas where the latter is weak or irregular in volume and pressure.

This class of apparatus is composed of a series of vertical cast or wrought iron cylinders into which bituminous coal is fed and burned under conditions which prevent free circulation of air in the combustion chambers, the operation being somewhat similar to that of producing ordniary coal gas, but the heat evolved is not so intense, and the gas is used without

being first purified by water scrubbing and desulphurizing. The hazard is nominal, as the producers are usually simply sheltered by a roof of metal on metal supports.

Decorating.—This class of work is found where oil lamps, lamp globes and shades, variety or novelty work is produced, and may range from gilding or other light ornamentation, entailing no particular fire hazard, to general decorative work by hand painting, decalcomania transfer, and/or stencil-work, the colors used being metallic oxides, thinned with turpentine, but in some instances it may be found that shading and tinting of the ware is accomplished by the use of colors held in solution in benzine or naphtha, sprayed upon the surface by an atomizer operating under air pressure, the flexible tubing connecting the atomizer with the naphtha supply being of rubber, and when in a dilapidated condition from use is liable to cause trouble through ignition of escaping naphtha or its vapor under constant air pressure, which is the equivalent of gravity supply.

It may also be noted at this point that the edges of globes and shades for lamps are trimmed, "flashed" or squared by the use of a gasoline or naphtha flame under air pressure, and that the bulk of the naphtha supply may be found in a metal receptacle in the cellar filled from the outside through rubber tubing. This process is considered especially hazardous under such conditions, and should be made safe under more modern and approved methods of practice. This hazard, where found, should be very carefully scrutinized, as it may prove of sufficient gravity to warrant declination of the risk.

Where oil lamps, novelty or variety wares are produced, metal parts or ornaments may also be made or be applied, thus creating hazards due to the use of lacquers and processes of buffing and polishing metal parts. When such process methods are found to exist careful investigation should be made in relation to the nature and quantity of lacquer and its solvent in daily use inside of premises, and as to where the bulk of such material is stored; also as to proper disposition of the waste or flyings from buffing and polishing wheels.

In cut glass working the process of producing designs for cutters has in recent years changed from the older practice of forming blanks upon which the designs were laid out by hand and developed on grinding or cutting wheels by skilled operators, to the use of metal pattern dies which impress the design upon the heated metal while the ware is being formed, and this pressed ware is then slightly cut on wheels and highly polished to sharpen and bring out the design, thus materially reducing the cost of production and increasing the possible output.

It is claimed that no cutting from blanks is now being done except on special orders. Such mechanical devices as may be used in producing cut glass are non-automatic in all processes, but necessitate employment of skilled operators.

Packing and Shipping.—The hazards of this branch of the glass business deserves considerable attention, from the fact that each class of product presents peculiarities of its own in the nature and quantity of material used for packing, as may be seen from the following notations:

Bottles of all kinds, fruit and milk jars, are usually shipped in slatted wooden crates, either without packing of any kind, or with corrugated straw-board strips between the layers of ware, and sometimes with a padding of straw or hay at the ends of the crate, thus presenting the minimum of hazard in this branch of the business.

Tumblers, lamp chimneys and tableware, pressed or molded, are usually shipped in barrels or casks, and a liberal quantity of hay, straw, excelsior and paper is used in packing, averaging two days supply in the packing room, with the bulk of such material kept on the premises in more or less remote and separated structures.

Lamp, variety and novelty ware plants use large quantities of the same packing material as do tumbler works, and ship their wares in barrels and casks, and average about the same conditions as to packing room and reserve supply of material for packing.

Warehouses are usually of large area, some of them immense, with stocks piled high in wooden or fibre cases and crates where bottle or similar stock is concerned, but in these instances without other inflammable material exposed; the storage of tumbler and table-ware is generally confined to goods in closed casks and barrels, mostly on ends; lamp, electric bulb, novelty and variety ware is stored in closed packages, and also in large quantity in open racks or shelves, each article being wrapped in tissue paper and presenting conditions for a flash-fire involving the complete destruction of the material exposed; this class of open storage is to be found inside of the factory buildings as well as in the warehouses.

Box and Package Making is generally without the preparation of the raw stock; box and crate shooks come in standard sizes, and are nailed by hand or machine; in some instances printing on shooks and sanding of box ends is carried on, and where proper blower systems are attached to the sanding devices and safety cans are provided for benzine or other detergent used for cleaning at presses, the hazard may be considered as mild.

Staves, headings and hoops for slack-barrel making reach the works in bundles and are set up or coopered on the premises, usually in separated structures, but occasionally inside of the main plants; barrel or stave-heating stoves are found to average fair in arrangement, but this feature presents a hazard warranting careful investigation, as does also the matter of cleanliness in the cooper shop.

The storage of box, crate and barrel stock is usually under cover of sheds or within enclosed structures, but where such material is piled in the open and exposed to sparks from locomotive engines or other sources, it presents an exposure hazard which should be very carefully considered.

Reviewing the fire hazards which may be assumed as being incident or inherent to any of the classes of glass works above treated, it does not appear that the worst of such hazards might not be materially reduced, if not entirely eliminated by proper foresight and exercise of good judgment in construction, arrangement of processes and in management supervision, the measure in which these essential conditions appear to be complied with, should influence acceptance or rejection of the hazard on inspection.

In summary of the hazards and present operative conditions in this branch of the glass industry, as developed during recent re-inspection of a large number of plants, it may be well to state that at the date of the first publication of this monograph in 1904, the methods of glass-ware production were beginning to feel the competitive influence of mechanical processes in substitution for hand labor in the production of bottles and other blown ware, through the introduction of semi-automatic machines producing so-called wide-mouthed ware, such as milk and preserve jars, this device being followed later by machines of such design as to automatically produce all grades of blown ware from ¼-ounce prescription vials up to ten-gallon demi-johns without the aid of skilled labor in any portion of the operation.

F. M. Griswold

General Inspector

New York, July, 1915.

The Inspector and the Insured

AN ADDRESS

DELIVERED BEFORE THE NINETY-FOURTH
MEETING

OF

The Insurance Society of New York

February 24th, 1914

BY

F. M. GRISWOLD
General Inspector

THE HOME INSURANCE COMPANY
NEW YORK

The Inspector and the Insured

Mr. President:

It affords me much pleasure to respond to your invitation to address this Society on the subject assigned me, for, I assume that in an assemblage of this character is to be found those whose presence is indicativé of a desire to profit by the teachings that may come to them through the lectures and addresses that are provided by the Society for their consideration and edification, whereby the information thus to be gained may serve to more fully fit its membership for that measure of success in their profession which should be the reward of earnest effort in the accumulation of knowledge affecting a chosen line of activity.

In attempting to impart to you my conception of the importance of the subject under consideration, I fear that within the time allotted it may not be possible to consider other than the leading points concerning a matter which includes so wide a field of essential knowledge relative to the varied and intimately mutual interests that exist between the insured and the insurer, the proper harmonizing of which so often falls to the lot of the competent inspector, whose measure of success and whose value to his employer, as also to the insured, largely depends upon a proper appreciation of the importance of these interlacing relations, the knowledge of which will enable him to accomplish best results with the least friction in his intercourse with the aggregation of "the many men of many minds" that make up the body of the insuring public, to whom in some instances, the inspector may appear as an unwelcome critic, if not as an intruder.

In considering the duties of an inspector as related to his contact with the insured, let me give you an outline of my conception of the necessary mental equipment to fit him for success in that line of endeavor:—primarily it may be conceded that the man who has had a technical education holds an advantage which should enable him to more rapidly advance in comprehension and accomplishment than usually falls to the lot of one not so endowed, but experience has

demonstrated that such foundation is not absolutely essential, as some have succeeded without it; however, when technical knowledge and scientific attainments are secured through the process of abrasion and attrition in the hard school of experience, the graduate has paid dearly for his lack of earlier training.

Whatever the method of technical accomplishment—whether it be founded on training in a technical school, or be the result of later effort, the aspirant for success as an Insurance Inspector should be somewhat familiar with insurance practice and be endowed with a broad complement of common sense; have an inquisitive and observant mind coupled with a desire to investigate the "why and how" of every problem; a constantly receptive brain, a retentive memory, an insatiable thirst for knowledge, and be possessed of that higher faculty which will enable him to be an imparter of knowledge, a teacher of those less thoughtful or less informed, and finally, to be imbued with such resourceful ingenuity and capacity as will fit him to plan and carry out the details of technical propositions to a successful issue.

Assuming that the inspector is "charged with knowledge" as well as with the other attributes indicated, it seems well to discover what is meant to be included in the interpretation of the word "inspect":—the dictionary defines it to be, "a critical examination; close or careful survey or investigation of something of special moment; to ascertain by examination the quality of work:"—hence, an inspector is "one whose duty it is to secure by supervision proper performance of work, in order to make a formal report."

Elaborating these definitions for application to the duties of the insurance inspector, let us broaden the word "work" to include in its meaning "condition," in the sense that the latter word represents the result of work performed, including the method and process which produces the condition creating and controlling the hazards to be investigated. Then, in order to comply with this broader interpretation of the definition, the formal report to be made by the inspector must be based upon the facts developed after a critical survey and examination of the nature and condition of all matters subject to his investigation.

Assuming for the purpose of illustration that the subject of inspection is that of a manufacturing plant or special hazard, it will then become necessary to closely scrutinize all matters which in any manner serve to create or to promote the fire hazard, including the character and nature of the raw stock or material to be used, following it through all processes of its manipulation, from its reception at the plant, its handling and storage, to the completion of the operations necessary to produce the finished goods or article, and to carefully note and define the hazards incident to each stage of progress where physical or other changes affecting the

conditions may take place, and in addition to these purely technical investigations and conclusions, to closely observe and study "shop practice" or management, including supervision and discipline of employees, as related to cleanliness and care of hazards which form the basis of "good housekeeping," which is one of the most important essentials in securing safety from fire in all classes of property.

The nature, means and method of fire prevention practices should be carefully investigated; the apparatus and appliances for fire protection or fire defence should be very critically examined and described; and when the assent and co-operation of the insured can be secured, tests for efficiency of such devices should be undertaken, but the inspector is cautioned not to make such tests on his own initiative without permission and co-operation. The nature and condition of the structures forming the plant or risk require careful consideration and full description, and finally, the information gained should be embodied in a written report of such lucidity as to convey a mental photograph of the hazards and conditions to the minds of those who have to decide upon the acceptability of the risk from an underwriting viewpoint.

I doubt not that to some of those present, even this much abridged summary of the primary duties of the inspector will appear arduous and difficult of accomplishment, because of the breadth of technical and general knowledge necessarily to be attained in order to comprehend even the salient points of the applied sciences which serve to create, promote or control the hazards of fire incident to business practices in this age of progress which gives to us each day some new and unknown problem for our study and solution as to its fire or life hazard.

However, none who aspires to success need be discouraged through contemplation of these seeming difficulties, for it should be remembered that all of the teachings of the past serve to admonish us that the fruition of hope for advancement in knowledge or estate, is the result of difficulties overcome and obstacles surmounted, and that the road to success still remains open and free to him who persistently strives to reach the goal, and he should therefore be encouraged to persevere, for, when fully qualified, the inspector stands on a high plane of usefulness as a conservator of public welfare in matters affecting the hazards of life and property, through his fitness to act both as mentor and guide to those who have not included the science of fire prevention and protection as an essential in mental and business training.

Holding this conviction as to the high station of the competent inspector, let us consider what should be his attitude in relation to his contact with the insured in matters connected with his inspection work;—primarily, the inspector should fully realize the fact that "every man's house is his castle," and therefore may not be invaded save

at the pleasure of its owner; the mere fact that an insurance company has assumed a contingent liability on the property in the form of an insurance policy, and therefore has a business interest in the risk, does not carry with it *any right of entry* save at the courtesy of its owner; and when such entry is gained, an investigation of conditions becomes a matter of sufferance, which may be rescinded at the pleasure or caprice of the owner.

Therefore, when an inspector is called upon to enter a plant for the purpose of inspection, he should first seek an audience with the owner or manager, to whom he should exhibit such credentials as will prove him to be authorized by his employer to make such inspection, and in a gentlemanly manner *ask the privilege* to make the investigation, carefully avoiding even the appearance of demanding an entry as a right, to the end that this preliminary of introduction may place the applicant for favor and the insured, who is to grant it, on mutual grounds of amicable courtesy.

Having gained permission to make inspection, it is always wise to briefly outline to the proprietor the purpose of the visit, and to give assurance that there is no intention to unduly pry into matters which do not affect the hazard, letting it be known that where such hazards are existent in the knowledge of the insured, but not readily discoverable through inspection, the mutual interests of both parties to the contract are best served when each strives to be frank with the other in such matters.

Approaching the insured in this manner usually results in securing his confidence on the start, and this condition may be materially reinforced by personally discussing with the insured conditions discovered which tend to create or to promote the fire hazard, not neglecting to express satisfaction where the management of the plant is to be commended, as a few words of deserved compliment go far to mollify antagonism engendered through criticism, for in some instances the insured may be found disinclined to admit the existence of defects cited by the inspector, basing his doubt upon his assumed knowledge of the conditions of his plant, and in such cases the position of the inspector is materially strengthened by his ability to point out the defect in place, and in the presence of the insured to make plain the reasons for suggesting the proposed betterments, which should be founded on "both the law and gospels" of accepted practice.

With this thought in mind, I desire to caution the Inspector against trusting to his memory as to conditions which need to be corrected, and to suggest that a special note be made in each case, indicating the nature of the defect and the locality in which it was discovered, rendering such items prominent by underscoring them with red or blue pencil, and using such points as his "texts" when in conference with the insured after an inspection, when, being sure

of his ground, the inspector should have the courage of his convictions and clean up all criticisms while on the premises and in the presence of the insured. Do not run away from an inspection and write to the insured in relation to matters which ought to be disposed of during your presence at the plant.

The practice of "cleaning up" as you go will be found of particular value, when, as is sometimes the case, the insured thinks he has a secret process, an unpatented machine or method in production in relation to which he is disinclined to permit investigation by an outsider, for in such instances the inspector is confronted with conditions demanding the exercise of consummate tact and diplomacy to overcome the suspicions of the insured that under the cloak of inspection, he may be harboring a spy from one of his rivals in trade, but as no two of such cases will be found so alike as to permit making a fast and hard rule of approach, the wit of the inspector must prove his guide in each case, but he should exercise a large measure of patience in attempting to overcome the objections offered by the insured, to whom it should be made plain that in order to make a report of value in the case, the inspector must personally observe and understand the hazards which may be incident to the hidden processes, and while willing to *believe* as truthful explanations made by the insured, it is impossible to *know* the conditions without personal investigation, and in order to fortify this position, the inspector should obligate himself not to divulge the information sought, and if then permitted to investigate, he is in duty bound to hold as absolutely inviolate the confidence thus reposed in him by the insured.

In case of an absolute denial of opportunity to look into the hazard of any supposed trade secret, the inspector must, per force, choose between two courses of action in order to make an intelligible report;—the easiest, and at the same time the most unsatisfactory decision would be to attempt reaching an conclusion as to the gravity of the unknown hazard by analogy predicated upon the nature of the processes and methods already developed by investigation of the risk under view, or from knowledge gained in like plants; but the safe and wiser course is to take the benefit of the doubt and get off the risk, when both argument and appeal fail to convince the insured that it is unwise to face a contingent liability depending upon unknown conditions; in other and more homely words, "never buy a pig in a poke."

Another problem which is difficult of solution to the satisfaction of either the skilled inspector or the insured, is the necessity for the correction of improper conditions brought about by the insistence of the tyro in inspection work; such for instance as forcing the placing of fire doors on each side of a brick basement division wall, when the floors and superstructure above the wall were entirely of

wood; insistence upon the hanging of a fire door at an opening between a brick factory building and its shed-roofed boiler house, while leaving the windows immediately above the combustible roof entirely unprotected; these two cases are cited from my personal experience, but many other illy advised conditions might be mentioned, some of which doubtless would be familiar to the experienced inspector.

In cases of this character, the insured is more or less justified in claiming that if forced to make changes and improvements in accord with the whim of every so-called inspector visiting his plant, his day of trouble will never end, but if the inspector is properly equipped with knowledge and diplomacy, he will be able not only to suggest the proper remedy, but be skilled enough to demonstrate the correct method of procedure to secure the desired results. A friendly discussion of such matters with the insured often brings satisfaction all around; even if the impression made does not result in immediate action for betterment, it is "seed well planted" and will bear its fruit in the future.

Reflecting upon what has just been said in relation to the difficulty of correcting errors in practice, due to the ignorance or self-sufficiency of the inexperienced inspector, I am led to caution you against that false pride which prevents the open acknowledgment of ignorance in relation to anything coming under observation, and cite for your encouragement that trite aphorism which admonishes us that "the realization of ignorance is the foundation of wisdom;" hence, as it is not given to any man to *know* everything, the wise inspector, when confronted with new and novel conditions, will evidence his wisdom by admitting his ignorance, and gain knowledge by asking questions and seeking explanations as to processes, causes and effects which may be new to him.

In my experience I have found a confession of ignorance of almost inestimable value under such conditions, and have learned much by throwing myself upon the generosity of the insured for enlightenment, finding them in almost every instance both willing and competent instructors when properly approached.

Unless the inspector is skilled enough to comprehend all of the hazards incident to the risk to be inspected without assistance from those familiar with the plant, he should seek to be accompanied by the proprietor, manager or other person in authority during his tour of inspection, in order to be enabled to point out defects as developed and to secure information as to hazards and conditions, the nature of which is not self-evident; when so accompanied, the inspector should realize that the absence of his guide from regular duties must entail expense upon the insured, but at the same time, should not permit himself to be unduly hurried in his work, as the value of the "formal report" to be made depends

upon the fullest comprehension of the matters investigated; take time enough to make the fullest notes of all conditions affecting the risk and influencing your conclusions at the time such matters come under your observation.

While there has here been given you the merest outline on some of the more important features which should be considered under a proper treatment of this important subject, let me in closing, again impress upon you the fact that the inspector, because of his calling, has no inherent right or authority to enter a plant for the purpose of inspection except by permission from its owner, nor has he power to enforce compliance in matters calling for changes, improvements or betterments, and should therefore confine his criticisms to such features as materially affect the hazards, and the amendment of which are essential to approval of the risk.

All necessary criticisms should be carefully considered by the inspector before submitting them to the insured, and should be presented in the nature of "suggestions" based upon accepted good practice, and in such manner as to convince the insured that compliance therewith will serve his best interests in the prevention or control of fire, making the argument "an appeal to reason." When the conditions criticised are such as to seriously jeopardize the safety of the plant, and immediate compliance with the suggestions cannot be secured, the only recourse is to get off from the risk, and the insured should be so advised, for while he is privileged to "take the chances" in such cases, the insurance company is not obligated to do so, and it is an evidence of sound underwriting to avoid any risk when it becomes necessary to threaten cancellation in order to secure promise of reform by the insured.

While the majority of men resent a *demand* to do anything which appears to reflect upon their method of business practice, almost every man will welcome friendly suggestions in criticism when so presented as to carry conviction of their feasibility and value in relation to the betterment of his own plant, and through this method the skilled inspector will many times succeed in securing needed reforms, even if he represent only a single company holding liability.

"Fire Insurance Engineering"

AN ADDRESS

DELIVERED BEFORE

The Fire Insurance Society of Philadelphia

BY

F. M. GRISWOLD
General Inspector

February 21st, 1905

THE HOME INSURANCE COMPANY
NEW YORK

"Fire Insurance Engineering"

Mr. President and Gentlemen of the Society:

Permit me to assure you that I appreciate very highly the privilege of appearing before you on this occasion, as I hold in much esteem the sentiment and purposes that prompted the organization of your Society as a medium through which might be disseminated information and knowledge of great value to its membership, whereby those who aspire to advancement in the profession of fire insurance may become better fitted to assume and intelligently handle the responsibilities which will come to them upon the consummation of their desires. It is therefore to be hoped that those who have the opportunity to attend your proceedings and listen to the various papers that may be presented and discussed, will seek to profit by the instruction thus imparted, and on such foundation proceed to erect a structure of knowledge honorable to themselves and creditable to the purposes and efforts of your Society in the line of education.

In undertaking to address you upon a topic so broad and inclusive in its possibilities as is that of "Fire Insurance Engineering," I fear that I may lay myself open to the charge of having taken counsel of temerity rather than of sound judgment, for, in approaching the subject, I realize that in order to properly present any one of the many phases of this new profession would require, and also warrant, more time than can now be devoted to the consideration of the topic as a whole, and therefore crave your indulgence if I confine my remarks to the outlines of this very important subject, it being my intention to leave to some more facile pen the task of elaborating its many phases of interest.

It has been said by an authority on the subject of insurance in general that "fire insurance is the most difficult of the main branches of insurance, on account of the constant and rapid changes in the circumstances which cause the hazard," and to those of us who have kept in touch with the advance in methods and processes in both mercantile and manufacturing industries during the past twenty-five or thirty years, the pointedness and accuracy of this statement will be apparent; and for this reason I trust you will kindly bear with me if I become somewhat reminiscent in attempt-

ing to make clear to you how the varied changes and circumstances incident to the growth of the insurance business have influenced specialization in practice to the point which marks the *raison d'etre* of this new profession, "Fire Insurance Engineering."

Going back now to a period in my personal experience, which if nominated might seem like a page from ancient history to some of my hearers, I recall that fire insurance was transacted under conditions which can, perhaps, be most aptly described by quoting the trite aphorism formulated by the late Col. A. F. Willmarth, while Vice-President of The Home Insurance Company, to the effect, that "this is a business of chances, therefore take all of the chances you can for the money you get," and, unfortunately, the same condition of mind controls the action of many companies even at this date of advanced knowledge of the conditions which produce the fire hazards against which the profession of Insurance Engineering is supposed to strenuously contend.

In those early days the profession of fire insurance was not held in high esteem, and the field-man was usually classed as being on a par with the itinerant lightning-rod vendor, notwithstanding his title of Special Agent. These early types of the insurance inspector were not, as a rule, charged with technical knowledge, but working under the doctrine of the aphorism above quoted, they made no effort to inspect a risk, as that term is now understood, the chief aims of such investigation as might be undertaken being the size of the line written, sometimes the moral hazard, but finally and conclusively the query, "will the rate obtained cover the chance of loss?" and each man had his own plan of guessing at the adequacy of the rate, and each claimed personal perspicacity in the art of correct guessing.

This "take the chances" method of supervision or inspection of risks continued to prevail for many years, but without demonstrating either profit for the companies or equality in the ratings of similar hazards as it was frequently the case that a single risk would be found written at as many different rates as there might be policies covering it, and not infrequently that the rates of one company would vary in proportion to the number of policies they had applying to the same risk.

The absurdity of this haphazard method of attempting to carry on a financial venture so important and complex as is fire insurance, impressed itself so deeply upon those who practiced it as to compel the admission that the whole system of underwriting was simply one of "magnificent guessing," and, perhaps, a realization of the degradation of this high profession to the level of the speculative spirit which formed the famous, but not forgotten, "South Sea" bubble episode, prompted the action which at about this time (1865) resulted in the formation of the National Board of Fire Under-

WRITERS, the organization of which marked the first successful effort to bring together the leading insurance companies of the country in concerted attempt to better the conditions by the adoption of a standard form of policy, and to centralize the rate-making power within the control of a single organization, evidently preferring organized "guessing" as against the individual and sporadic efforts which had prevailed in the past in the matter of rates.

While the methods and practices of the National Board of Fire Underwriters during the time it continued to act as an authoritative rating body cannot be said to have established any of the principles of insurance inspection or insurance engineering as now applied, the centralization of the function of rate-making in that body alone served to materially abridge the field for free-hand rate guessing by the special agent and at the same time prompted the thoughtful underwriter to make a deeper study of his profession, forcing upon him a realization that perhaps a reduction of hazard through betterment of conditions in construction, processes and fire protection might induce a lower loss ratio and thus warrant a lower rate charge. This trend of thought was doubtless emphasized through the fact that at about this period the New England Mutual companies (then known as the "Manton Mutuals") began to be markedly aggressive, and their methods of inspection appealed not only to the good sense of the mill owners but also to that element in the stock insurance interests which had reached the justifiable conclusion that all fire insurance is mutual in its character and that, therefore, any means which serves to reduce the fire hazard is of equal importance to both the insured and the insurer. In other words, "what is good for the insurer is also good for the insured," for the reason that any modification of the fire hazard tends to reduce the probability of loss and at the same time warrants, and, usually, should secure, consideration in reduction of rate to the benefit of both parties.

This partial conception of the absolute mutuality of the insurance contract as between the insurer and the insured proved too radical a departure from old-time stock insurance practice to meet with general approval, but it may, perhaps, be truthfully stated that the honor of first attempting the conduct of fire insurance inspections and acceptances on these lines by any stock organization can be ascribed to the officers of the North American Fire Insurance Company of New York (wrecked in the Chicago fire of 1871) at my suggestion, in the year 1868, at which time I had the honor to represent that company as its assistant general agent.

At about this period in the chronology of the advancement in fire insurance practice occurred that wonderful awakening in the applied sciences and mechanic arts which served to revolutionize old methods and bring into use new combina-

tions in chemical, general manufacturing and mercantile methods and processes, inducing the creation of new and practically unknown fire hazards, which placed the inspector who depended upon the "guessing process" of rate-making as related to fire hazard in a very uncomfortable position through the lack of that modicum of technical knowledge which alone would enable him to keep pace with these marvelous changes in circumstances and conditions, and this situation of uncertainty on the part of the inspector as to what measure of hazard might be provoked under these new processes and methods was vastly aggravated by the equal ignorance of such possibilities upon the part of the manufacturer or other insured, whose only purpose in the adoption of a new method or process was the hope of profit, without the least apparent concern as to what might be the result in the line of added fire risk until, as a consequence of his temerity, would come a fire of supposedly mysterious origin.

It is to be confessed that these early attempts at the betterment of physical conditions and the control of fire hazards did not meet with immediate and cheerful compliance upon the part of some of the insured of those days, any more than it usually does on the part of the same class of the present day, but the measure of success achieved served to encourage continued effort, and in time other companies took up the idea; but as yet there was no concert of action in such matters, and the progressive special agent or inspector met with much opposition from the manufacturer or other insured in his attempts to develop and comprehend these new conditions of hazard, because every one who adopted a new system or process was inclined to consider the special knowledge thus held to be as important as a state secret, and strenuously resented any attempt at investigation; indeed, any suggestions for betterment of conditions which the inspector might offer, however well considered and patent they might be, were frequently treated with contumely, if not with derision; hence it may be assumed that the lot of the inspector of those days did not permit him to "wander in pastures green and lie down by still waters," nor was his bed always one of roses.

The next step in the advancement of insurance practice was apparently the result of general dissatisfaction with the somewhat arbitrary aggrandizement of power by the National Board, which, as it grew in strength of membership, assumed to ignore both the local agent and local conditions in the matter of rate-making, and in an effort to ameliorate these untoward conditions there came about the formation of local or district organizations as rating bodies, which, while assuming jurisdiction, were not directly affiliated with the National Board, and these bodies, each working independently of the other, undertook the formulation of a system of schedule rating which was supposedly best suited to

cover the peculiarities of its own locality, constructed on a broad base-rate for specified hazards, with supplemental charges in more or less specific detail for known or supposed hazards of processes or conditions, and these specific charges were imposed on the assumption that the income from same would cover the probability of fire loss, but there appeared no intention to avoid such charges by counsel and advice to the insured in relation to the elimination or modification of the hazards.

Closely following the inception of this later system, and practically conjunctional with it, came a stage of progress in the practice of fire insurance which was based upon a deeper appreciation of the mutuality of the obligations existing between the insured and the insurer, which should prompt each to seek means for the elimination or minimizing of the probability of loss by the exercise of proper precautions for the prevention of fire, rather than to collect compensation in advance for unknown chances by the imposition of a rate charge.

As a result of this awakening to a realization of the high plane of usefulness to which the profession of fire insurance might justly aspire as the conservator of public welfare, there arose that concert of action between some of the leading insurance companies which not only sanctioned, but encouraged the formation in many localities of bureaus and associations whose functions of operation were not only to be entirely divorced from the question of rate-making, but were to be specialized in relation to the investigation of the fire hazards due to processes, methods and faults in management, and to the means for proper fire prevention and fire protection, together with instruction of the insured in relation to the most approved methods by which these ends might best be accomplished to the mutual advantage of all at interest.

This radical departure from old-time methods necessitated the employment of men as inspectors who were sufficiently skilled in technical matters to enable them to not only discover hazardous conditions, but also to be possessed of that ingenuity and resourcefulness which would permit them to intelligently suggest, and if necessary personally apply, the proper and practical remedy for correction of the defects under criticism, and while it is lamentably true that we sometimes find enforced compliance with a suggestion for supposed betterment which does not appear to serve its proper or intended purpose, owing to the lack of practical experience or well-founded knowledge upon the part of the inspector or engineer who has formulated the suggestion, it may be justly assumed that such instances are the exceptions which serve to test the rule, because of the fact that the general results of the work accomplished by the skilled inspector or engineer has wrought such marked and sur-

prising reductions in fire hazard and promoted such changes of value in relation to betterments in processes in manufacture as to demonstrate the fact that through skilled inspection and the enforcement of well considered means of fire prevention and fire protection, the element of "chance" in the fire insurance business may now be considered as minimized to an extent which has heretofore not been hoped for.

All of the teachings of history admonish us that the fruition of hope for the betterment of the condition of mankind is the result of difficulties overcome and of obstacles surmounted, and progress in the advancement of the practice of fire insurance is in support of the historical precedent; and, while it is perhaps unwise to assume that complete fruition has supervened in our profession, it is safe to say that the process is well advanced, and as a result there has been unconsciously brought into being a new element in that complex organization of commercial necessity known as Fire Insurance.

This new element, gentlemen, is personified in the Insurance Engineer, and he stands before us to-day almost full-fledged and of vigorous action; but who may nominate the date of his conception, and who name his putative father? His birth was unheralded, and his christening was not accompanied by ceremony, song, wine or merrymaking; he was self-named; but yet it is no disparagement to his lineage to say that the Insurance Engineer is the child of necessity.

Having now traced the advancement of fire insurance practice from that period in its history when its methods were not far removed from the primitive to that point where more scientific methods of procedure promise to place it on the plane of exact science, let me submit for your consideration my personal conception of the qualifications necessary in the mental and other equipment of the man who aspires to become a successful Inspector or Insurance Engineer, and in an attempt to elucidate this problem it appears proper to begin by defining the meaning of the terms "Engineer" and "engineering."

Each of these words or terms is generic in character and cover in their application a wide range of sub-division into special classes, and, in considering their proper definition, we find, by implication at least, that those who assume the title of Engineer should be persons charged with knowledge and skill in relation to the principles and practice of one or more of the branches or departments of engineering, and, therefore, be possessed of such resourceful ingenuity and capacity as will fit them to plan and carry out the details of technical propositions to successful issue; hence, it should be appreciated that the title of Engineer is not to be lightly assumed by those who lack these qualifications of knowledge and capacity, lest when the crucial test comes these presumptuous individuals may find themselves abashed at the dis-

covery of their incompetence, not only to their personal discredit, but also to the disparagement of an honorable profession.

In the broad field of nomenclature of the arts and sciences, that subdivision which includes the comprehensive term "engineering," is found to cover many special branches of the art of interest to the Fire Insurance Engineer, which from their importance or inclusiveness have become familiar to the public, such, for instance, as civil engineering, chemical engineering (including the creation of many new products and consequent new hazards, due to the electrolytic process), electrical engineering, hydraulic engineering, construction engineering (including as a specialty fireproof construction); heating and ventilation engineering, sanitary engineering, municipal engineering, and it is therefore apparent that each of these specialties present an almost unlimited possibility for expansion in research and accomplishment, and that each of the experts in any of these branches of science needs only to devote his energies to the development of his specialty in order to almost daily present to the expectant world some marvelous achievement, and thereby confront the Insurance Inspector or Engineer with new conditions in methods and processes which will tax his ingenuity to properly control and safeguard against the probability of fire, and this result can be attained only after a complete mastery of the secrets involved in these developments of scientific research and varied experimentation.

This citation of some of the more prominent branches of the art of engineering is made with the purpose of presenting for your consideration the vastness of concentrated knowledge which must be attained in order to comprehend even the salient points in the various divisions of applied science, and I expect that I will be considered presumptuous when I maintain that the requirements for the possession of knowledge, skill and adaptiveness which are requisite to fit one to become a successful insurance inspector or engineer are fully as exacting and perhaps more inclusive than are those which are deemed necessary to fit one to assume title in any other branch of engineering; and in support of this assumption, let me ask you, gentlemen, what general or specific qualification of fitness which is considered essential in other branches of engineering may be omitted from the capacity or comprehension of the qualified insurance inspector or engineer of this day and generation?

The profession of fire insurance engineering is yet too young to warrant the graving of its title upon the entablatures of the halls of applied science, but let us not therefore conclude that it is not entitled to this honored distinction, for, in my estimation, it, of all branches or departments of engineering, holds within the broad scope of its warranted aspirations of accomplishment the possibility of proving

itself the wise and accredited conservator of the public welfare in relation to all matters affecting the hazards of life and property, thus performing a function in the amelioration of the condition of mankind, which in the countries of the Old World is rightly assumed to be a measure of governmental concern and control.

As the field of operation of the insurance engineer has become expanded and its value as an entity in the progress of utilities of business practice has become more highly and properly appreciated, its operations, like those of other branches of engineering, are being segregated into specialties, the elaboration of each branch of its application commanding the service of those skilled in the specialty. Hence we find demonstrated as an example of this tendency to sub-division that body of qualified experts known as "The Committee of consulting Engineers," with extensive laboratories at Chicago, where all classes of tests and experiments are carried out in the development of the weaknesses, hazards or good qualities of specific devices and processes, and on the results of these tests and experiments are formulated the requirements upon which are established and promulgated (under the sanction and approval of the National Board of Fire Underwriters) a series of standards authoritative in character and of equal force upon underwriting bodies in all portions of the country.

In addition to this work upon the specific items which go to the making or the curing of fire hazards, as part of the work of the Fire Insurance Engineer, we have that broader branch of the profession, which, under the guidance of "The Committee of Twenty" of the National Board, is composed of a body of highly-trained technical experts who are now very thoroughly investigating the conflagration hazard and the conditions of water supply and fire department efficiency in many of the leading cities of the country. It will thus be apparent that the field for specialization in the profession of Insurance Engineering is not more restricted than it is in other lines of engineering accomplishment, and that, therefore, he who aspires to distinction may find ample scope for the exercise of his faculties in the development of that special quality of recognized capacity which most strongly appeals to him as being his province in the work of Insurance Engineering.

Having now broadly, and, I confess, very imperfectly laid down some of the qualities called for in the equipment of the competent Insurance Inspector or Engineer, it seems well to give consideration to the question as to what are the mental and personal requisites best fitting a man for success in this new profession, and it can be said primarily that while complete technical school training should insure to its possessor more rapid advancement in comprehension and accomplishment than usually falls to the lot of one not so

favored, experience has demonstrated that such endowment is not an absolute necessity, as some men have succeeded without it; but, gentlemen, when technical and scientific attainments are secured through the process of abrasion and attrition in the hard school of experience, the graduate has paid dearly for his lack of earlier training.

Whatever the method of technical accomplishment—whether it be that secured through early training in a school, or whether it be the result of later effort, the aspirant for success as an Insurance Inspector or Engineer must be endowed with a broad complement of common sense, an inquisitive mind, evidenced by a desire to investigate "Why and How"; a constantly receptive brain, a retentive memory, an insatiable thirst for the absorption of knowledge and the possession of that higher faculty which will enable him to be an imparter of knowledge, a teacher of those less thoughtful or less informed, and, finally, to become almost an anchorite in devotion to his chosen profession.

Realizing that I have already trespassed upon your patience and courtesy to an almost inexcusable extent, I cannot refrain from a few remarks in conclusion, and these apply to the personality of the Insurance Inspector or Engineer in relation to the execution of his frequently very trying duties. Let him remember when he enters a risk that "every man's house is his castle, and he may defend it"; therefore be suave and gentlemanly, and avoid the arrogance of assumed or presumed authority; when you have recommendations for betterment to offer, let your method be suggestive, not mandatory; but, above all, let such requests be based on that foundation of knowledge and practicability which will include "both the law and the gospels," and therefore be beyond reasonable criticism.

Finally, while we may all be justly proud of the achievements thus far accredited to this new entity of Insurance Engineering, and some of us may ascribe to ourselves a noticeable credit in its forwarding, let me caution you to a realization of the fact that upon each of us rests a personal responsibility to make good the future conduct and record of this stripling in science, to the end that its achievements may equal its opportunities for the betterment of the condition of mankind.

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